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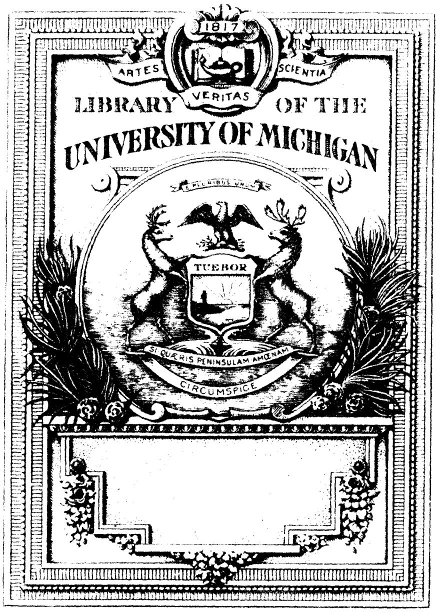

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SEPTEMBER TO DECEMBER, 1935
WITH 36 PLATES AND 7 TEXT FIGURES

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MANILA

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Eulogio Rodriguez, A.B., *Secretary*
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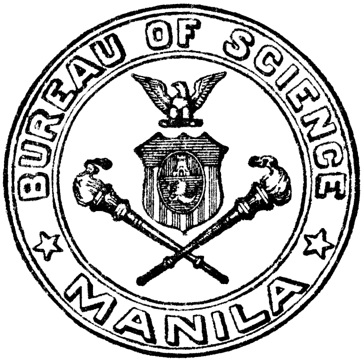

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THE PHILIPPINE
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VOL. 58 SEPTEMBER, 1935 No. 1

# A REVISION OF THE PHILIPPINE LORANTHACEÆ

By B. H. DANSER

*Of the Botanical Laboratory of the University, Groningen, Netherlands*

TWO PLATES

A revision of the Philippine Loranthaceæ has already twice been given, though in a more concise form, by Merrill.[1] The present revision is, in many respects, only an extension of Merrill's. New are the keys for all genera and species; the complete descriptions for all species, usually after all materials available; the distribution lists as complete as possible; and many criticisms of the nomenclature. In many points, such as the synonymy of older Philippine literature, I have had to follow Merrill blindly; also it deserves to be mentioned that the careful labeling of the material in the Bureau of Science herbarium and the clear indication of good types are Merrill's work.

I am, however, also greatly indebted to Dr. Eduardo Quisumbing, curator of the Philippine National Herbarium, Bureau of Science, for his kindness in twice sending me the Philippine Loranthaceæ—once to Buitenzorg and once to Groningen. Also to the directors of other herbaria, who kindly sent me Philippine Loranthaceæ to be taken up in my revision, I feel very thankful. The herbaria from which material was received are here listed:

B; Herbarium of the Botanic Gardens, Buitenzorg, Java.
Be; Herbarium of the Botanic Garden and Museum, Berlin-Dahlem.
Br; Herbarium of the Botanic Garden of the University, Breslau.
G; Herbarium of the Botanical Laboratory of the University, Groningen.

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[1] Philip. Journ. Sci. § C 4 (1909) 129–153; Enum. Philip. Fl. Pl. 2 (1923) 100–114.

L; The State Herbarium, Leiden.
M; Philippine National Herbarium, Bureau of Science, Manila.
NY; Herbarium of the New York Botanical Garden, New York.
S; Herbarium of the Botanic Gardens, Singapore.
U; Herbarium of the Botanical Laboratory of the University, Utrecht.
UC; Herbarium of the University of California, Berkeley.

As a result of my revision I can mention for the Philippines seventeen genera with eighty-six species of Loranthaceæ, eleven of which are new to science. Only seventeen of these species are also found outside the Philippines, so that sixty-nine must be regarded as endemic.

To keep the revision as concise as possible, I have refrained from mentioning vernacular names and, except in a few cases, the host trees, as these are of no use, unless the author is well acquainted with Philippine languages and with the Philippine flora. For these I must refer to Merrill's revision or to further literature. For more-extensive synonymy of some species I have taken the liberty of referring to my own revision of the Loranthaceæ of the Netherlands Indies.

*Key to the genera of the Philippine Loranthaceæ.*

1. Leafless ..... 2.
   Leafy ..... 3.
2. Internodes of each stem flattened in one plane; no bracts between the flowers ..... XV. *Korthalsella.*
   Flattenings of the internodes alternating; bracts below the flowers. XVII. *Viscum.*
3. Perianth 2 mm long or less, calyxlike; flowers unisexual ..... 4.
   Perianth longer than 3 mm, corollalike; flowers hermaphrodite ..... 6.
4. Young parts tomentose ..... XVI. *Notothixos.*
   Young parts glabrous ..... 5.
5. Flowers in spikes ..... XIV. *Ginalloa.*
   Flowers single or crowded in the leaf axils ..... XVII. *Viscum.*
6. Anthers dorsifixed, versatile; corolla choripetalous. XIII. *Phrygilanthus.*
   Anthers basifixed ..... 7.
7. Flowers single or in sessile few-flowered umbels ..... VII. *Amyema.*
   Flowers in capitate inflorescences ..... 8.
   Flowers in simple peduncled umbels ..... 10.
   Flowers in simple racemes or spikes ..... 13.
   Flowers in umbels of triads (or rarely dyads) ..... 16.
   Flowers in racemes or spikes of triads (or rarely dyads). I. *Amylotheca.*
8. Involucre not composed of bracts, cup-shaped ..... III. *Cyne.*
   Involucre composed of six small bracts placed in one whorl. VIII. *Dicymanthes.*
   Involucre composed of decussate, imbricate bracts, rarely the innermost pair connate to a calyptra ..... 9.

9. Flowers more than twelve, placed on a flat receptacle and surrounded by the involucral bracts, at least the outer flowers arranged in triads. II. *Lepeostegeres.*

Flowers four or less in number, in two decussate pairs. VI. *Lepidaria.*

Flowers in triads in the axils of the bracts, each flower surrounded by three smaller bracts.................................... IV. *Thaumasianthes.*

10. Corolla choripetalous ........................................ VII. *Amyema.*

Corolla sympetalous ........................................ 11.

11. Below each flower three (or by concrescence two) bracts; flower 6-merous ........................................ V. *Macrosolen.*

Below each flower a single bract; flower 4-merous.................................... 12.

12. Calyx tube and fruit attenuate towards the base............ XI. *Scurrula.*

Calyx tube and fruit not attenuate towards the base........ XII. *Taxillus.*

13. Corolla choripetalous ........................................ IX. *Helixanthera.*

Corolla sympetalous ........................................ 14.

14. Below each flower three (or by concrescence two) bracts; flower 6-merous ........................................ V. *Macrosolen.*

Below each flower a single bract; flower 4- or 5-merous........................ 15.

15. Calyx tube and fruit not attenuate towards the base; fruit ovate; flower 5-merous ........................................ X. *Dendrophthoe.*

Calyx tube and fruit attenuate towards the base; fruit clavate; flower 4-merous ........................................ XI. *Scurrula.*

16. Style breaking off at the base, leaving no beak or nipple on the fruit. VII. *Amyema.*

Style breaking off somewhat above the base, leaving a beak or nipple on the fruit; flower 6-merous, sympetalous; whole plant glabrous. I. *Amylotheca.*

## I. Genus AMYLOTHECA Van Tieghem, emended

*Amylotheca* VAN TIEGH., Bull Soc. Bot. Fr. 41 (1894) 261; 42 (1895) 444; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 300; 11 (1931) 238; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 35.

*Treubella* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 265; 42 (1895) 86, 435; non Pierre (1890).

*Aciella* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 435; 42 (1895) 86, 445.

*Decaisnina* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 435.

*Arculus* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 444.

*Treubania* VAN TIEGH., in Morot, Journ. de Bot. 11 (1897) 324.

Inflorescentia plerumque racemus, rarius spica vel umbella, triadum (raro dyadum), floribus singula bractea suffultis. Flores plerumque 6-meres raro 5-meres, choripetali vel magis minusve sympetali, petalis vel laciniis corollae erectis supra insertiones staminum reflexis vel rarius recurvis. Antherae basifixae, angustae, acutae vel obtusae, loculis 4 vulgo continuis rarious locellatis. Stylus plerumque supra basin articulatus, fructui rostrum breve relinquens, raro basi articulatus.

*Amylotheca* is distributed all over the Philippines. Outside the Philippines it is spread in a southern, and especially in a southeastern, direction to Australia and New Caledonia.

The Philippine species of *Amylotheca* show more different forms than those of the eastern parts of the Malay Archipelago. *Amylotheca viridis* and *A. pentagona* together form an endemic section, restricted to Luzon; *Amylotheca ovatifolia, A. saccata,* and *A. Aherniana* constitute a second section, to which also *A. duthieana,* from the Malay Peninsula and the Lingga Archipelago, and *A. borneana,* from Borneo, belong; *Amylotheca crassilimba* unites characters of the already mentioned sections with those of the following one. Therefore, it is *A. crassilimba* that makes it impossible to split *Amylotheca* into smaller genera. The last section contains all remaining species of the Philippines and the further Malay Archipelago and might be called *Amylotheca* sensu strictiore; among these the Philippine species have much shorter flowers, on the average, than those of the Netherlands Indies.

### *Key to the Philippine species of Amylotheca.*

1. Corolla thick, more than 5 mm wide in the lower part, blackish in herbarium specimens, 30 to 45 mm long; anthers obtuse; lateral flowers of the triads pedicellate; twigs and leaves crowded............ 2.
   Flowers not like this ........................................................................ 3.
2. All triads placed in an umbel or few of them placed somewhat lower on the peduncle; pedicels of the triads 12 to 17 mm long, those of the lateral flowers 4 to 8 mm long; corolla and style 30 to 47 mm long; twigs terete or obtusely angled................................ 16. *A. viridis.*
   All triads racemosely arranged; pedicels of the triads 8 to 10 mm long, those of the lateral flowers nearly 3 mm long; corolla and style 40 to 45 mm long; twigs with nearly five sharp angles.
   17. *A. pentagona.*
3. Inflorescence with an involucre of decussate scales at the base of the peduncle; lateral flowers of the triads pedicelled; anthers obtuse; style leaving no nipple on the fruit........................................................ 4.
   Inflorescence without involucre of scales at the base of the peduncle; lateral flowers of the triads sessile or shortly pedicelled; anthers acute; style usually leaving a nipple on the fruit.......................... 7.
4. Corolla strongly dilated in the lower portion........................................... 5.
   Corolla hardly or not at all dilated in the lower portion...................... 6.
5. Style 23 to 32 mm long; triads in each inflorescence nearly 6 to 12.
   15. *A. Aherniana.*
   Style 14 to 18 mm long; triads in each inflorescence nearly 12 to 32.
   14. *A. saccata.*

6. Corolla 5-merous, like the style 20 to 23 mm long; axis of the inflorescence 5 to 10 mm long, bearing six to eight triads; twigs slender ........ 13. *A. ovatifolia.*
   Corolla 6-merous; corolla and style 22 to 23 mm long; axis of the inflorescence 30 to 65 mm long, bearing six to eighteenth triads; twigs and leaves thick and coarse; bracts usually falling off before anthesis ........ 12. *A. crassilimba.*
7. Young twigs quadrangular; inflorescence densely but very shortly puberulent; style nearly 20 mm long; anthers nearly sessile. 10. *A. confertiflora.*
   Young twigs terete, internodes more or less flattened towards the top, in extreme cases double-edged ........ 8.
8. Corolla and style 21 to 32 mm long ........ 9.
   Corolla and style 12 to 21 mm long ........ 14.
9. The two sides of the leaf distinctly different ........ 10.
   The two sides of the leaf hardly different; corolla and style 26 to 30 mm long; free part of the filament 3 to 7 mm long. 9. *A. formicaria.*
10. Free portion of the filament 0 to 1.5 mm long ........ 11.
    Free portion of the filament 1.5 to 4 mm long ........ 12.
11. Leaves elliptic-oblong, thick, long-petioled, of the nerves only the midrib distinct; bracts falling off before anthesis. Compare with *A. crassilimba,* usually having an involucre of scales at the base of the inflorescence and usually having shortly pedicelled lateral flowers of the triads.
    Leaves distinctly nerved on both sides, the lamina convex between the strongest lateral nerves ........ 8. *A. miniata.*
12. Leaves exactly elliptical, thick, with indistinct lateral nerves. 11. *A. revoluta.*
    Leaves more irregular-shaped, with distinct lateral nerves ........ 13.
13. Leaves sessile, deeply cordate; stem dichotomous at nearly all nodes; corolla thickish, nearly 33 mm long ........ 7. *A. amplexicaulis.*
    Leaves more or less petioled, not or rarely slightly cordate; corolla not thickish, 23 to 30 mm long ........ 6. *A. boholensis.*
14. Corolla and style 15 to 21 mm long ........ 1. *A. Cumingii.*
    Corolla and style 12 to 15 mm long ........ 15.
15. Triads sessile ........ 2. *A. apodotrias.*
    Triads pedicelled ........ 16.
16. Flowers 5-merous; leaves roundish-cordate, equal on both sides, thick. 5. *A. Hopeae.*
    Flowers 6-merous ........ 17.
17. Leaves slightly cordate, sessile; free portion of the filament 1 to 2 mm long ........ 4. *A. Merrillii.*
    Leaves petioled, ovate-lanceolate; anthers sessile ........ 3. *A. tenuis.*

### 1. AMYLOTHECA CUMINGII Van Tieghem.

*Amylotheca Cumingii* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 264; 42 (1895) 444; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 300; 11 (1931) 251; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 36; MERR., Enum. Philip. Fl. Pl. 2 (1923) 110.

*Elytranthe Cumingii* ENGLER, in Engler and Prantl., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 126.

*Loranthus mindanaensis* MERR., Philip. Journ. Sci. 1 Suppl. (1906) 186; § C 4 (1909) 142; ELMER, Leafl. Philip. Bot. 3 (1911) 1070; MERR., Enum. Philip. Fl. Pl. 2 (1923) 107 excl. specim.

*Loranthus secundiflorus* MERR., Philip. Journ. Sci. 1 Suppl. (1906) 187, § C 4 (1909) 141–142; Enum. Philip. Fl. Pl. 2 (1923) 109.

*Loranthus subalternifolius* MERR., Philip. Journ. Sci. 1 Suppl. (1906) 188, § C 4 (1909) 141; Enum. Philip. Fl. Pl. 2 (1923) 110.

*Loranthus fragilis* MERR., Philip. Journ. Sci. § C 9 (1914) 278 non Sprague (1910); LECOMTE, Not. Syst. 3 (1914) 175.

*Loranthus secundiflorus* Merr. var. *bolsteri* ELMER, Leafl. Philip. Bot. 3 (1911) 1067; MERR., Enum. Philip. Fl. Pl. 2 (1923) 109.

*Loranthus aurantiacus* ELMER, Leafl. Philip. Bot. 6 (1913) 1967; MERR., Enum. Philip. Fl. Pl. 2 (1923) 102.

*Loranthus palawanensis* MERR., Philip. Journ. Sci. § C 13 (1918) 279; Enum. Philip. Fl. Pl. 2 (1923) 107.

*Amylotheca palawanensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 302; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 38.

Omnino glabra, vel inflorescentiis et floribus juvenilibus papillose puberulis. Ramuli subgraciles, internodiis junioribus teretibus apicem versus applanatis vel raro basi tantum teretibus apicem versus magis applanatis ancipitibus, vetustioribus nodis incrassatis, folia adulta ferentibus basi 1 ad 3.5 (raro ad 5) mm crassis, 2 ad 14 cm longis. Folia opposita vel subopposita; petiolus longitudine variabili et in formis praecipue angustifoliis difficile a lamina distinguendus, basi incrassatus, subtus valde supra leviter convexus, 0 ad 15 mm longus, 1 ad 3 mm latus; lamina valde variabilis, saepe irregularis, faciebus paulum diversis, utrinque opaca, plerumque tenuiter coriacea raro crassa, 5 ad 15 cm longa, 1.5 ad 9 cm lata, obovata vel elliptica vel oblonga vel ovata vel ovato-lanceolata, basi plerumque in petiolum attenuata, rarius rotundata vel leviter cordata magis abrupte contracta subsessilis, margine integerrima, apice rotundata vel obtusa, vel vario modo irregularis, raro subacuta vel acuminata, penninervis, costa facie inferiore magis prominente quam superiore, nervis lateralibus et venis facie superiore leviter prominentibus, inferiore indistinctis. Inflorescentiae racemi triadum floribus omnibus sessilibus, singulae vel gregatim in axillis foliorum et in nodis defoliatis; axis teres, ad insertiones florum paulum incrassatus, 15 ad 70 mm longus, supra basin 1 ad 1.5 mm crassus, supra 10 ad 20 mm, inferiora nuda 3 ad 7 paria triadum ferens; pedicelli triadum teretes, 1 ad 4 mm longi, 0.5

mm crassi; bracteae rotundato-ovatae, apice rotundatae vel magis acutae, 1 ad 1.5 mm vel si acutae ed 2 mm longae, concavae. Calicis tubus subcylindricus, 2 ad 3.5 mm longus, 1 ad 1.25 mm latus; limbus plerumque late patens, 0.5 ad 1 mm longus, crenatus vel leviter lobatus. Corolla crassiuscula, statu alabastri adulti 15 ad 21 mm longa, supra partem basalem brevissime cylindricam vix 0.5 mm longam valde dilatata, 2.5 ad 4 mm lata, deinde ad duas tertias longitudinis sensim ad 1.5 ad 2 mm attenuata, apicem rotundatum versus subcylindrica, postea in petala 6 (rarius 5?) omnino libera vel in tubum campanulatum circiter 3 mm longum et latum cohaerentia dehiscens, laciniis e basi c. 1 mm lata in tertia parte inferiore sensim attenuatis, deinde c. 0.5 mm latis ad 4 ad 5 mm ab apice reflexis, parte reflexa anguste spathulata apice incrassata obtusa. Stamina 6; filamenti pars libera 0 ad 1 mm longa; anthera 2.5 ad 4 mm longa, acuta, basi facie inferiore appendice brevi, loculis 4 continuis. Stylus 15 ad 21 mm longus, supra basin paulum incrassatam articulatus, papillam 0.25 ad 0.75 mm longam in fructu relinquens; stigma capitatum, apice styli C. sesquiplo crassus. Fructus ellipsoides, ad 8 mm longus, ad 5 mm crassus, styli rudimento et calicis limbo permanentibus coronatus.

It is probable that all these synonyms belong to one species, and I doubt that the following four species will prove to be distinct after examination of additional material. Anyhow, *Amylotheca Cumingii* is a polymorphic species spread all over the Philippines, though in northern Luzon it is less common; it occurs from sea level to 2,300 m altitude.

The color of the corolla apparently varies in the same way as in the nearly related *A. triflora* (Spanoghe) Dans.; according to the notes on different herbarium labels and to Elmer[2] it may be red, golden yellow, orange, or red in the lower part, yellow in the upper part, or rarely pale yellow, or red and white, in most cases with greenish (perhaps sometimes black) tip.

Philippine Islands, without exact locality, *Cuming 1969*, cotypes of *Amylotheca Cumingii* Van Tiegh. = *Loranthus subalternifolius* Merr. (M, L, Be, the latter labeled by Van Tieghem); "Unisan," *Comisión de la flora forestal de Filipinas 1694* (L). LUZON, Mountain Province, Benguet Subprovince, Sablan *Elmer 6191* (M, NY, S, Be): Rizal Province, *Loher 12228* (M) and *14481* (M, UC); Montalban, *Loher 13370* (M, UC): Tayabas

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[2] Leafl. 3: 1067–68; 6: 1067–69.

Province, Alabat Island, low altitude, *Bur. Sci. 48068 Ramos and Edaño* (M, NY, UC, B): Camarines Norte Province, Mount Cauagan, 80 m altitude, *Ramos 2053* (M, NY, S, L, Be): Camarines Sur Province, Botol River, 720 m elevation, *Bur. Sci. 76320 Edaño* (M, NY): Sorsogon Province, Mount Pocdo, 200 m altitude, *Bur. Sci. 23347 Ramos* (M, NY, S, L, B). CATANDUANES, Mount Manguidor (?), 170 m altitude, *Bur. Sci. 30442 Ramos* (M); Domingo River, 37 m altitude, *Bur. Sci. 30535 Ramos* (M); Mount Abucay, 1,500 m, *Bur. Sci. 75347 Ramos and Edaño* (M, NY, B). LEYTE, Bao, 0 m altitude, *F. B. 16981 Rosenbluth* (M). DINAGAT, iron deposit, *Bur. Sci. 83932 Ramos and Convocar* (M). MINDANAO, Surigao Province, 15 m elevation, *Bolster 237* (M, UC), type of *Loranthus secundiflorus* Merr., *Bolster s. n.* (M, NY, Be); *Bur. Sci. 34352* (M) and *34376* (M, Be, B) *Ramos and Pascasio;* Placer, *Wenzel 2518* (M, NY, UC, B): Agusan Province, Mount Urdaneta, Cabadbaran, *Elmer 13774* (M? B, NY, L) cotypes of *Loranthus aurantiacus* Elm.: Davao Province, Davao, 3 m altitude, *Weber 1460* (M); *Copeland 341* (M), *Williams 2580* (M, NY); Darong, *Williams 26995* (M, NY); Lobulan, *Warburg 14767* (Be); Mount Apo, 690 m altitude, *Devore and Hoover 285* (M); Mount Apo, Todaya, *Elmer 11701* (M, NY, L) cotype of *Loranthus secundiflorus bolsteri* Elm., *Elmer 11995, 11996* (M, NY, B, U); Malalag, Santa Cruz, 10 m altitude, *F. B. 27549 De Mesa* (M): Lanao Province, Lanao and Balabak Trail, 1,150 m altitude, *F. B. 25233 Alvarez* (M); Camp Keithley, *Clemens 545* (M, Be): Zamboanga Province, Sax River, *Williams 2419* (M, NY). BASILAN, *Hallier 513* (M, NY). SULU ARCHIPELAGO, Jolo, 780 m altitude, *Clemens 9338* (M). PALAWAN, Taytay, sea level, *Merrill 9248* (M, type, NY, S, B, L, cotypes of *Loranthus fragilis* Merr. non Sprague = *Loranthus palawanensis* Merr.).

### 2. AMYLOTHECA APODOTRIAS Danser sp. nov.

Glaberrima. Ramuli subgraciles, internodiis junioribus basi teretibus, apicem versus valde applanatis, folia adulta ferentibus 2 ad 2.5 mm crassis apice ad sesquiplo crassioribus, vetustioribus teretibus apice incrassatis. Folia opposita vel subopposita; petiolus supra planus vel obtuse carinatus, prope basin incrassatam subteres, 1.25 ad 2 mm crassus, 5 ad 10 mm longus; lamina elliptica vel paulum ovata, crassiuscule coriacea, ad 8 cm longa 4 cm lata, e basi cuneata paulum in petiolum decurrens, margine integerrima vel paulum irregularis, apice obtusa, faciebus paulum diversis opacis, penninervis, costa supra leviter sub-

tus valde prominente, nervis lateralibus supra distinctis subtus minus distinctis. Inflorescentiae spicae triadum floribus omnibus sessilibus; axis teres, basi et insertionibus triadum incrassatus, 10 ad 15 mm inferioribus nudus, ceterum 2 ad 5 paribus triadum, prope basin 1 ad 1.5 mm crassus, apicem versus paulo tenuior; bracteae suborbiculares obtusae, 1 ad 1.5 mm longae. Calicis tubus cylindricus, c. 3 mm longus 1.25 mm latus; limbus infundibuliformis, c. 0.75 mm longus, integer. Corolla c. 13 mm longa, statu alabastri adulti supra basin brevissime cylindricam c. 1 mm longam, 0.5 ad 0.75 mm latam ad 2 ad 2.5 mm dilata, dimidiam longitudinem versus sensim ad dimidian latitudinem attenuata, parte superiore prismatica, apice obtusissima; postea in lacinias 6 usque ad c. 3 mm supra basin dehiscens, tubo campanulato, laciniis e basi c. 1 mm lata primum sensim ad dimidiam latitudinem attenuatis ceterum aequilatis, ad c. 3 mm ab apice reflexis parte reflexa anguste spathulata obtusa. Stamina 6; antherae sessiles, c. 2 mm (?) longae acutae. Stylus prismaticus 6-angularis, dimidia superiore sensim paulum incrassatus, paulum supra basim articulatus, rostrum breve calicis tubo subaequilongum in fructu relinquens; stigma obtusissimum, styli apice vix crassius. Fructus ellipsoides, maturus ignotus, calicis tubo permanente et styli basi coronatus.

*Amylotheca apodotrias* is closely related to *A. Cumingii* and is, perhaps, an extreme form of it. I provisionally list it as a separate species because of its sessile triads and very short flowers.

MINDANAO, Lanao Province, Lake Lanao, Camp Keithley, *Clemens s. n.* (M, type).

### 3. AMYLOTHECA TENUIS Danser sp. nov.

Omnibus partibus tenuis, glaberrima. Rami internodiis juvenilibus basi teretibus apicem versus valde applanatis ancipitibus nonnumquam etiam complanate quadriangulis, folia adulta ferentibus basi c. 1.5 mm crassis apicem versus ad duplo latioribus, vetustioribus magis teretibus nodis incrassatis, saepe costis 2 permanentibus. Folia opposita; petiolus supra planus subtus obtuse carinatus, supra basin paulum incrassatam teres, difficile a lamina distinguendus, ad 1.25 mm crassus, ad 7 mm longus; lamina ovato-lanceolata, ad 8 cm longa, ad 3.5 cm lata, e basi cuneata in petiolum attenuata, margine integerrima, apicem obtusiusculum versus longiuscule acuminata, penninervis, costa supra subplana distincta subtus valde prominente obtuse carinata, nervis lateralibus venisque supra subdistinctis, subtus indistinctis. Inflorescentiae racemi triadum floribus omnibus sessilibus, in axillis foliorum adultorum positi; axis 5 ad 17 mm longus basi c. 0.75 mm crassus apicem versus attenuatus, 1 vel 2 (raro 3?) paria florum ferens; pedunculi triadum 2 ad 4 mm longi, c. 0.3 mm crassi; bracteae obtuse ovatae vel suborbiculares, c. 0.5 ad 0.75 mm longae. Calicis tubus cylindricus, c. 3 mm longus, 0.6 mm latus, limbus late infundibuliformis c. 0.5 mm longus integer. Corolla statu alabastri adulti c. 11 mm longa, dimidia parte inferiore ellipsoides ad 2.5 mm lata, superiore magis cylindrica, apice obtusa, postea in lacinias 6 dehiscens, tubo campanulato c. 3 mm longo, laciniis basi c. 1 mm latis, in 2 ad 3 mm inferioribus ad dimidiam latitudinem attenuatis ceterum lingulatis obtusis, c. 2 mm ab apice reflexis. Stamina 6; antherae sessiles, c. 2 mm longae, acutiusculae, loculis 4 continuis. Stylus aequicrassus, c. 11 mm longus; stigma obtusissimum stylo paulo crassius. Fructus ellipsoides, maturus ignotus, calicis tubo permanente coronatus.

*Amylotheca tenuis* certainly is closely related to *A. Cumingii*, and it is perhaps an extreme form of that species, but the very short flowers and the short inflorescences with rather long-pedicelled triads, induced me to name it as a distinct species.

LUZON, Rizal Province, Montalban, *Loher 12393* (M, type, UC).

### 4. AMYLOTHECA MERRILLII (Elmer) Danser.

*Loranthus Merrillii* ELM., Leafl. Philip. Bot. 3 (1911) 1068; MERR., Enum. Philip. Fl. Pl. 2 (1923) 107.

*Amylotheca Merrillii* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 301; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 38.

Glabra, inflorescentiis juvenilibus densissime puberulis exceptis. Ramuli subgraciles, internodiis juvenilibus basi teretibus apicem versus magis minusve applanatis plerumque ancipitibus, vetustioribus mox teretibus nodis incrassatis, plerumque costis 2 permanentibus, folia adulta ferentibus basi 1 ad 4 mm crassis apice duplo latioribus vel etiam magis dilatatis, 1.5 ad 7 cm longis. Folia opposita vel subopposita, sessilia; lamina ovata vel cordata vel oblongo-ovata, 3.5 ad 9 cm longa, 2 ad 6 cm lata, crassiuscule coriacea, faciebus distincte diversis, superiore paulo magis lucida quam inferiore, basi rotundata vel leviter cordata, margine integerrima vel irregularis, paulum revoluta, apice obtusa vel rotundata, penninervis, costa supra plana distincta, subtus valde prominente, nervis lateralibus venisque utrinque prominentibus, facie superiore distinctioribus quam inferiore. Inflorescentiae racemi triadum floribus omnibus sessilibus, in axillis foliorum positae; axis teres, basi paulum incrassatus insertionibus triadum paulum dilatatus, 20 ad 60 mm longus, supra basin c. 1 mm crassus, apicem versus sensim paulum attenuatus, in 10 ad 15 mm inferioribus nudus, ceterum paribus 3 ad 5 decussatis triadum; pedunculi triadum teretes, 1 ad 2 cm longi, 0.5 crassi; bracteae suborbiculares, c. 1 mm longae, concavae. Calicis tubus subcylindricus, c. 2.5 mm longus 1 mm latus; limbus late infundibuliformis vel patens, leviter lobatus, c. 0.5 mm longus. Corolla statu alabastri adulti c. 13 ad 15 mm longa, basi ad 1.5 mm dilatata, ad dimidiam longitudinem sensim angustata, ceterum cylindrica sed ad c. 3 mm ab apice abrupte paulum incrassata, obtusissima, postea omnino vel fere omnino dehiscens in petala 6 basi c. 0.75 mm lata, versus insertiones staminum sensim ad dimidiam latitudinem attenuata, ceterum angustissime spathulata, apice crassiuscula obtusa, ad 3 ad 4 mm ab apice reflexa. Stamina 6; filamenti pars libera 1 ad 1.5 mm longa; anthera c. 2 mm longa, acuta, loculis 4 continuis. Stylus 13 ad 15 mm longus, prope basin et apicem paulo crassior, supra basin articulatus, rostrum 0.25 ad 0.5 mm longum in fructu relinquens. Stigma obtusissimum, styli apice c. sesquiplo crassius. Fructus ignotus ("Young fruit ellipsoid," Elmer, loc. cit.).

According to Elmer (loc. cit.) the corolla is "with a yellowish zone below the blunt bud tips, otherwise bright red."

*Amylotheca Merrillii* is closely related to *A. Cumingii*, but I prefer to keep it as a separate species because of the twigs that soon thicken; the greater difference between the two surfaces of the leaves and more cordate base; the shorter, less thickish corollas; and the filaments with a longer free portion.

MINDANAO, Davao Province, Mount Apo, Todaya, 1,800 m, *Elmer 10617* (M, B, L, NY, U, cotypes of *Loranthus Merrillii* Elm.).

Doubtful specimen: LUZON, Sorsogon Province, Mount Bulusan, Irosin, *Elmer 17328* (M), without open flowers.

### 5. AMYLOTHECA HOPEAE (Merrill) Danser.

*Loranthus hopeae* MERR., Philip. Journ. Sci. § C 9 (1914) 279; Enum. Philip. Fl. Pl. 2 (1923) 105.

*Amylotheca Hopeae* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 301; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 37.

Glaberrima, inflorescentiis densissime brevissime puberulis exceptis. Ramuli graciles, internodiis juvenilibus teretibus, nodis valde incrassatis, 3 ad 11 cm longis, folia adulta ferentibus medio 1.5 ad 3 mm crassis, nodis ad duplo crassioribus. Folia opposita, sessilia; lamina cordato-oblonga ad rotundato-cordata, 5 ad 9 cm longa, 3.5 ad 5 cm lata, crasse coriacea, faciebus vix diversis, semilucidis, subglaucis, costa utrinque leviter prominente venis partim visibilibus. Inflorescentiae racemi triadum decussatarum, floribus omnibus sessilibus, singulae in axillis foliorum superiorum; axis ad 2.5 cm longus (M), teres, nodis leviter incrassatus, paribus triadum paucis plerumque 2 (M), pedunculis triadum 5 ad 10 mm longis (M) ; bracteae rotundato-ovatae obtusae semiamplexicaules, c. 1.25 longae, convexae, reflexae. Calicis tubus subcylindricus, 2.5 mm longus, 1 mm latus; limbus patens, 0.5 mm longus, integer. Corolla "5-merous, 12 mm long, puberulent externally, slightly inflated, cylindric, the lobes united for the basal 3 to 4 mm, forming a tube, the reflexed part above the insertion of the anthers oblong-obtuse, 2.5 mm long. Anther lanceolate, sessile, 2 mm long" (M).

I have seen the type specimen only, but this is not sufficient to verify the parts of the description taken by me from Merrill's and indicated with (M).

*Amylotheca Hopeae* is peculiar by its unusual leaf, and its rather long, cylindrical twigs strongly thickened at the nodes. The flowers are said to be 5-merous, but I could not affirm this statement for lack of flowers. The corolla is described as orange, with the tips of the petals glaucous.

MINDANAO, Zamboanga Province, opposite Olutanga, 20 m elevation, *F. B. 13297 Foxworthy, Demesa, and Villamil* (M), type of *Loranthus Hopeae* Merr.

**6. AMYLOTHECA BOHOLENSIS (Merrill) Danser.**

*Loranthus boholensis* MERR., Philip. Journ. Sci. § C 4 (1909) 141; LECOMTE, Not. Syst. 3 (1915) 175; MERR., Enum. Philip. Fl. Pl. 2 (1923) 103.

*Loranthus agusanensis* ELMER, Leafl. Philip. Bot. 6 (1913) 1962; MERR., Enum. Philip. Fl. Pl. 2 (1923) 102.

*Loranthus terminaliflorus* ELMER, Leafl. Philip. Bot. 6 (1913) 1970; MERR., Enum. Philip. Fl. Pl. 2 (1923) 110.

*Amylotheca agusanensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 300; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 35.

*Amylotheca boholensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 300; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 36.

Omnis glabra, inflorescentiis nonnunquam brevissime puberulis exceptis. Ramuli graciles; internodiis junioribus teretibus apicem versus applanatis, folia adulta ferentibus 4 ad 10 cm longis, 2 ad 5.5 mm crassis, nodis ad duplo crassioribus. Folia opposita vel subopposita; petiolus supra basin paulum incrassatam subteres, supra anguste applanatus vel leviter canaliculatus, laminam versus magis applanatus, infra rotundatus, 3 ad 15 mm longus, 1.5 ad 2 mm latus; lamina crassiuscule coriacea, faciebus distincte diversis, ovato-lanceolata vel ovato-oblonga vel ovata, 6 ad 20 cm longa, 3 ad 7 cm lata, basi rotundata breviter in petiolum contracta vel magis cuneata, raro leviter cordata, margine integerrima saepe irregularis, saepe paulum revoluta, apicem obtusiusculum versus sensim attenuata vel magis minusve acuminata, facie superiore opaca vel semilucida, inferiore saepe luteola vel rufa, penninervis, costa supra prominente subtus magis prominente, nervis lateralibus venisque supra leviter prominentibus distinctis subtus minus distinctis. Inflorescentiae racemi triadum breviter pedicellatarum floribus omnibus sessilibus, singulae vel paucae in axillis foliorum; axis 15 ad 50 mm longus, teres insertionibus triadum paulum incrassatis, supra basin c. 1 mm crassus, super partem inferiorem nudam 5 ad 32 mm longam paribus c. 2 ad 8 triadum decussatis; pedicelli triadum 0.5 ad 1.5 mm longi, c. 0.5 ad 0.75 mm crassi; bracteae rotundato-triangulares, convexae, 0.75 ad 1 mm longae, obtusissimae. Calicis tubus cylindricus, c. 2 mm longus, 1 ad 1.25 mm latus, limbus magis vel minus infundibuliformis, 0.3 ad 0.5 mm longus, subinteger. Corolla status alabastri adulti c. 23 ad 30 mm longa, gracilis, supra basin c. 1 mm latam vix vel ad 2 mm dilatata, ad duas tertias longitudinis ad dimidiam latitudinem attenuata, deinde cylindrica, in 2.5 ad 4 mm superioribus leviter ellipsoides ad 1 mm crassa, apice obtusa, postae in 6 (raro 5) petala dehiscens, tubum subcylindricum vel paulum inflatum 1 ad 4 mm longum relinquens, lacinitis e basi c. 0.75 mm lata sensim attenuatis, supra insertiones staminum reflexis, parte superiore reflexa 5 ad 7 mm longa angustissime spathulata c. 0.25 ad 0.4 mm lata subobtusa. Filamenti pars libera 1.5 ad 4 mm longa; anthera angustissima acutissima, 3 ad 4 mm longa. Stylus filiformis, 23 ad 30 mm longus, 0.25 ad 0.50 mm supra

basin articulatus, rostrum breve in fructu relinquens; stigma anguste clavatum, stylo c. sesquiplo crassius, obtusissimum. Fructus ellipsoides, immaturi maximi c. 8 mm longi, 5 mm crassi, calicis limbo indistincto et styli parte basali coronati.

I have already reduced *Loranthus agusanensis* and *terminaliflorus* to one species.[2] Further studies prove that *L. boholensis,* though rather strongly different as to the type specimen, is connected by intermediate forms with the species above mentioned and consequently cannot be kept as a separate species. The distribution of *Amylotheca boholensis,* as delimited by me, is remarkably continuous. It occurs from sea level to 1,500 m elevation.

The corolla of *A. boholensis* is red, or red below and yellow above, or green at the tip, as in most species of *Amylotheca.*

GUIMARAS, 100 m elevation, *F. B. 101 Gammill* (M, NY). NEGROS, Occidental Negros Province, Momnun, 150 m, *F. B. 11229 Everett* (M) ; Gimagaan River, 80 m, *Whitford 1489* (M) ; Canlaon Volcano, *Bur. Sci. 1164 Banks* (M, Be). BOHOL, Tagbilaran, beach cliff, *Bur. Sci. 1277 McGregor* (M, type, NY, Be, cotypes of *Loranthus boholensis* Merr.). LEYTE, Mount Abucayan, 270 m, *Bur. Sci. 41705 Edaño* (M, B, L, Be). DINAGAT, low altitude, *Bur. Sci. 84091 Ramos and Convocar* (M). BUCAS GRANDE, low altitude, *Bur. Sci. 35133 Ramos and Pascasio* (M). MINDANAO, Agusan Province, Mount Urdaneta, Cabadbaran, *Elmer 13405* (M, B, L, U, NY, UC, Be, cotypes of *Loranthus agusanensis* Elm.) ; Mount Urdaneta, near Lake Doñao, 1,500 m elevation, *Elmer 14156* (M, B, L, cotypes of *Loranthus terminaliflorus* Elm.).

### 7. AMYLOTHECA AMPLEXICAULIS Danser sp. nov. Plate 1, figs. 1 and 2.

Omnis glabra. Ramuli subgraciles, quoque fere nodo dichotomi, internodiis junioribus nodis primum dilatatis deinde incrassatis sesquiplo vel duplo crassioribus quam medio, 3 ad 10 cm longis, folia adulta ferentibus, 1.5 ad 4 mm crassis. Folia opposita, sessilia; lamina ovata vel oblongo-ovata, 4 ad 12 cm longa, 1.5 ad 5 cm lata, basi leviter cordata, maxima latitudine in quarta parte longitudinis, margine subregularis, integra, plana, versus apicem in acumen saepe longum protractum sensim attenuata, crassiuscule coriacea, faciebus distincte diversis, superiore opaca vel semilucida, obscurior, inferiore opaca, regulariter penninervis, costa supra leviter prominente distinctissima, sub-

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[2] Bull. Jard. Bot. Buitenzorg III 10: 300.

tus valde prominente, nervis lateralibus venisque tenuioribus supra leviter prominentibus subdistinctis subtus vix visibilibus. Inflorescentiae racemi triadum floribus omnibus sessilibus, singulae vel paucae in axillis foliorum summorum vel etiam superiorum, valde secundae, involucro nullo sed nonnunquam margine corticis circumdatae; axis teres, 30 ad 55 mm longus, supra partem inferiorem 5 ad 10 mm longam nudam paribus triadum 5 ad 10 decussatis, basi 1 ad 2 mm crassus, apicem versus paulum attenuatus; pedicelli triadum 0.75 ad 1 mm crassi, 1 ad 1.5 mm longi, teretes; bracteae rotundato-triangulares, obtusae, c. 1 mm longae, margine albidae. Calicis tubus cylindricus vel campanulatus, c. 2 mm longus, 1.25 mm latus; limbus magis vel minus infundibuliformis, c. 0.5 mm longus, integer vel leviter lobatus, margine albidus. Corolla statu alabastri adulti c. 33 mm longa, supra basim rotundatam c. 2.5 mm lata, tertia parte inferiore ad dimidiam latitudinem attenuata, tertia parte media subcylindrica, in 7 ad 8 mm superioribus abrupte in clavam ellipsoidem obtusam dilatata, postea omnino partita in petala 6 a basi 1.25 mm lata usque ad insertionem staminis ad 0.4 mm attenuata, parte superiore reflexa 7 mm longa anguste spathulata vel sublineari c. 0.5 mm lata obtusa. Filamenti pars libera c. 2.5 mm longa; anthera c. 4 mm longa, acuminata, loculis 4. Stylus filiformis, c. 33 mm longus, stigma clavatum obtusum vel obtusissimum versus nonnihil incrassatus. Cetera ignota.

This is, perhaps, an extreme form of *Amylotheca boholensis*, but differs from that species, as it is known at present, by the sessile amplexicaulous leaves, the strongly dichotomous twigs, the thicker corolla, and the longer corolla and style.

MINDANAO, Misamis Province, Mount Candoon (Mount Bunanan), 1,500 m, *Bur. Sci. 38740 Ramos and Edaño* (M, type, L, B, Be, cotypes).

### 8. AMYLOTHECA MINIATA (Elmer) Danser.

*Loranthus miniatus* ELMER, Leafl. Philip. Bot. 6 (1913) 1966 non sp. Moore (1897); MERR., Enum. Philip. Fl. Pl. 2 (1923) 107.

*Amylotheca miniata* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 301; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 38.

Omnis glabra. Ramuli subrobusti sed graciles, internodiis junioribus teretibus nodis incrassatis, folia adulta ferentibus 6 ad 12 cm longis, 3 ad 6 mm crassis. Folia opposita, sessilia; lamina ovata vel ovato-oblonga, basi subcordata, apicem obtusiusculum versus sensim attenuata vel subacuminata, 15 ad 23 cm longa, 7 ad 12 cm lata, faciebus valde diversis, superiore subglauca opaca, inferiore flavida vel subfusca, opaca, penninervis, costa supra prominente subtus crassiore, nervis lateralibus et nonnunquam etiam venis utrinque subdistinctis inter nervos crassiores convexa subbullata, margine leviter recurva. Inflorescentiae in axillis foliorum, racemi densi triadum floribus omnibus sessilibus; axis teres, 1.5 ad 3 (ad 8 sec. Elmer) cm longus, paribus triadum numerosis; pedicelli triadum 1 ad 2 cm longi; bracteae suborbiculares obtusissimae, c. 0.75 mm longae. Calicis tubus 2 ad 2.5 mm longus, 1 ad 1.25 mm latus subcylindricus; limbus patens, 0.3 ad 0.5 mm longus, integer vel sublobatus. Corolla statu alabastri adulti 25 ad 28 (ad 30 sec. Elmer) mm longa, subprismatica, in 2 mm inferioribus leviter inflata, in parte superiore antheras continente leviter incrassata, ceterum 1 ad 1.5 mm crassa, obtusa, postea partita in petala 6 linearia parte inferiore paulum dilatata c. 0.5 mm lata, usque ad 5 mm ab apice sensim attenuata 0.3 mm lata, ibi reflexa, parte reflexa anguste lanceolata subobtusa. Filamenti pars libera 0 ad 1 mm longa; anthera linearis acuta, c. 5 mm longa, loculis 4 continuis, facie interiore basi saepe appendice brevi. Stylus filiformis, corolla aequilongus; stigma obtusum styli apice vix crassus. Cetera ignota.

*Amylotheca miniata* has the leaves strikingly large, coarse, the two sides distinctly different, and with the lamina convex between the strongest nerves; the flowers are long, the free parts of the filaments short. The differences from *A. boholensis* are not large, but up till now I could keep it apart from that species.

Elmer describes the flower as "vermillion red from the base to within two-thirds of the top, then a white or creamy white band and the apical one-third murinus in color;" upon the label of another specimen the flower is called red.

SIARGAO, low altitude, *Bur. Sci. 34886 Ramos and Pascasio* (M, UC, S). MINDANAO, Agusan Province, Mount Urdaneta, 375 m, Cabadbaran, *Elmer 13276* (M, B, L, U, NY, UC, Be, cotypes of *Loranthus miniatus* Elmer): Davao Province, Bonawan, 20 m, *For. Bur. 27707 Angeles and Selorio* (M).

**9. AMYLOTHECA FORMICARIA (Elmer) Danser.**

*Loranthus formicarium* ELMER, Leafl. Philip. Bot. 3 (1911) 1069; (*-ius*) MERR., Enum. Philip. Fl. Pl. 2 (1923) 104.

*Amylotheca formicaria* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 301; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 37.

Omnis glabra. Ramuli graciles, internodiis junioribus teretibus apicem versus applanatis et dilatatis, vetustioribus nodis incrassatis, folia adulta ferentibus 2.5 ad 6 cm longis, medio 1.5 ad 5 mm crassis, nodis ad sesquiplo crassioribus. Folia opposita vel subopposita; petiolus subnullus vel ad 3 raro 5 mm longus plerumque lamina decurrente alatus, supra basin incrassatam 1 ad 2.5 mm crassus, subtus magis convexus quam supra; lamina ovata ad lanceolata, 5 ad 17 cm longa, 1 ad 5.5 cm lata, plerumque sub basi rotundata in petiolum contracta, raro in petiolum attenuata, margine saepe irregularis, apice obtusa vel rotundata, faciebus vix diversis opacis, penninervis, nervis omnibus utrinque visibilibus, costa subtus paulo magis prominente quam supra, nervis ceteris supra paulo distinctioribus quam subtus. Inflorescentiae racemi triadum breve pedicellatarum floribus omnibus sessilibus, singulae vel paucae in axillis foliorum, secundae; axis teres, 25 ad 40 mm longus, basi et insertioribus pedicellorum paulum incrassatus, supra basin 1 ad 1.5 mm crassus, apicem versus sensim paulum attenuatus, 10 ad 20 mm inferioribus nudus, ceterum paribus 3 ad 6 decussatis triadum; pedicelli triadum 1 ad 2 mm longi, 0.5 ad 1 mm crassi teretes; bracteae suborbiculares, 0.75 ad 1 mm longae, concavae. Calicis tubus subcylindricus vel leviter ellipsoides, 2 ad 2.5 mm longus c. 1 mm latus; limbus magis vel minus infundibuliformis, integer vel sublobatus c. 0.5 mm longus. Corolla statu alabastri adulti subcylindrica, basi vix dilatata, parte superiore paulo crassior quam medio, 26 ad 30 mm longa, 1 mm crassa, postea dehiscens in lacinias 6, tubo cylindrico 3 ad 5 mm longo, laciniis linearibus e basi 0.5 mm lata ad tertiam partem longitudinis attenuatis deinde ad c. 0.5 mm dilatatis, 7 ad 10 mm ab apice reflexis, apice obtusis. Filamenti pars libera 3 ad 7 mm longa; anthera 2.5 ad 3.5 mm longa linearis acuta loculis 4 continuis. Stylus filiformis, corolla aequilongus, supra basin articulatus rostrum c. 0.5 mm longum in fructu relinquens; stigma stylo c. sesquiplo crassius obtusissimum. Fructus ellipsoides a calicis limbo permanente et styli basi coronatus (maturus ignotus).

*Amylotheca formicaria* is distinguished by its leaves being short-petioled and the two sides hardly different, the long slender flowers, the corollas hardly widened above and below when in

bud, and the long filaments. Yet it is not always easily distinguished from *A. boholensis*. According to herbarium labels the corolla is red below, and yellowish green above.

BOHOL, Sevilla, 1,000 m elevation, *Bur. Sci. 43331 Ramos* (UC, B, Be). MINDANAO, Misamis Province, Cagayan, *Piper 173* (M), *151* (Be): Lanao Province, Camp Keithley, Lake Lanao, *Clemens s. n.* (M, Be?): Davao Province, Mount Apo, Todaya, *Elmer 11304* (M, NY, B, L) cotypes of *Loranthus formicarium* Elm.: Cotabato Province, Bagumbayan, 12 m elevation, *Bur. Sci. 11578 C. B. Robinson* (M).

**10. AMYLOTHECA CONFERTIFLORA (Merrill) Danser.**

*Loranthus confertiflorus* MERR., Philip. Journ. Sci. § C **13** (1918) 273; Enum. Philip. Fl. Pl. 2 (1923) 103.

*Amylotheca confertiflora* DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 300; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 **29** 6 (1933) 36.

Glabra, inflorescentiis et floribus densissime puberulis exceptis. Ramuli subrobusti; internodia juvenilia acute quadriangula apicem versus paulum applanata, vetustioriam dum folia ferunt crassiore magis teretia 2 ad 7 cm longa, 2.5 ad 7 mm crassa. Folia opposita; petiolus teres, prope laminam supra canaliculatus, 11 ad 14 mm longus, basi ad 3 mm crassus, laminam versus tenuior 1 ad 2 mm crassus; lamina ovato-lanceolata, 8 ad 15 cm longa, 2 ad 4 cm lata, maxima latitudine prope basin rodundatam saepe in petiolum contractam, apicem longe acuminatum obtusiusculum versus sensim attenuata, faciebus valde diversis, tenuiter coriacea, supra semilucida subglauca, inter nervos crassiores convexa, subtus minus lucida badiuscula, penninervis, costa supra distincta subtus valde prominente, nervis lateralibus venisque supra partim prominentibus distinctis, subtus multo minus distinctis. Inflorescentiae racemi densi triadum floribus omnibus sessilibus; axis cylindricus c. 3 cm longus (sec. Merrill); pedicelli triadum vix 1 mm longi, c. 0.5 mm crassi; bracteae ovatae, obtusae, semiamplexicaules c. 1.5 ad 2 mm longae. Calicis tubus c. 1.5 mm longus, 1 mm latus, subcylindricus; limbus patens c. 0.5 mm longus, distincte 6-lobus. Corolla statu alabastri adulti 6-angularis, 1.5 ad 2 mm inferioribus distincte in partem ellipsoidem dilatata ad 1.5 mm lata medio c. 1 mm lata, parte apicali antheras continente ellipsoides, apice obtusa, postea dehiscens in lacinias 6, tubo c. 3 mm longo paulum inflato, laciniis e basi c. 0.75 mm lata sensim ad 0.5 mm attenuatis, parte apicali c. 3 mm longa reflexa crassiuscula obtusa paulo latiore.

Antherae subsessiles c. 3 mm longae, angustae acutae vel acuminatae, loculis 4 continuis. Stylus filiformis subaequicrassus c. 20 mm longus; stigma vix crassius obtusum. Cetera ignota.

This is different from all other Philippine species of *Amylotheca* by the 4-angular twigs; from most of them, moreover, by the papillose-puberulent young inflorescences and flowers. The color of the flower is said to be red.

LEYTE, Tigbao, near Tacloban, *Wenzel 1249* (M).

11. **AMYLOTHECA REVOLUTA** (Merrill) Danser.

*Loranthus revolutus* MERR., Philip. Journ. Sci. § C 4 (1909) 142; Enum. Philip. Fl. Pl. 2 (1923).

*Amylotheca revoluta* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 302; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 38.

Glaberrima. Ramuli subgraciles, internodiis junioribus nodis valde applanatis non incrassatis, folia adulta ferentibus 0.8 ad 2.5 cm longis, 2 ad 4.5 mm crassis, vetustioribus teretibus nodis incrassatis. Folia opposita; petiolus supra basin incrassatam teres, laminam versus subtus paulum supra distincte applanatus marginibus acutis, difficile a laminae basi contracta distinguendus, ex parte excepta c. 10 mm longus, 1.5 mm latus; lamina elliptica, maxima latitudine circa medium, 5 ad 8 cm longa, 2 ad 3.5 cm lata, basi cuneata in petiolum contracta, margine integro subrevoluta, apice obtusa, crassiuscule coriacea, faciebus valde diversis, superiore subglauca inferiore badiuscula, regulariter penninervis costa supra distincta subtus valde prominente, nervis lateralibus crassioribus supra distinctis vel indistinctis, subtus semper multo minus distinctis, venis vix visibilibus. Inflorescentiae racemi triadum flore medio sessili, floribus lateralibus breviter pedicellatis, singulae vel gregatim in nodis iam defoliatis, in scrobiculis corticis insertae sed involucre bracteoso carentes; axis teres nodis incrassatis et complanatis, 3 ad 3.5 cm longus supra basin incrassatam 1.5 mm crassus, apicem versus attenuatus, paribus triadum c. 4 in media parte superiore vel etiam magis apicem versus aggregatis; pedicelli triadum c. 2 mm longi, 0.75 mm crassi, pedicelli florum lateralium c. 1 mm longi, 0.75 mm crassi; bracteae rotundato-ovatae obtusae amplexicaules 1 ad 1.5 longae parte apicali albidae, saepe irregulariter laceratae. Calicis tubus cylindricus vel subellipsoides, c. 2.5 mm longus, 1 mm latus, limbus patens c. 0.25 ad 0.35 mm longus distincte sed saepe irregulariter obtuse lobatus. Corolla statu alabastri adulti 22 ad 25 mm longa, subcylindrica vel prismatica, basi et parte apicali antheras continente paulum incrassata medio c. 1.5 mm crassa, postea dehiscens in petala 6 basi magis vel minus cohaerentia sublinearia, basi 0.75 mm lata, versus apicem c. 0.5 mm latum sensim attenuatis, in 5 ad 6 mm superioribus reflexis lanceolatis ad 0.75 mm latis subacutis. Filamenti pars libera 1.5 ad 2 mm longa; anthera linearis acutissima, loculis 4 continuis. Stylus 22 ad 25 mm longus filiformis subaequicrassus basi articulatus. Fructus immaturus ellipsoides, calicis tubo et disco coronatus.

This species is similar to *Amylotheca crassilimba,* but differs in the twigs being slenderer, the leaves more exactly elliptical, the inflorescences bearing flowers in the upper part only, the flowers smaller in all parts, and the bracts permanent. The corolla is described as yellow with a red tip.

LUZON, Zambales Province, Mount Tapolao, 2,100 m, *Bur. Sci. 4785 Ramos* (M): Mountain Province, Ifugao, Mount Polis, *Bur. Sci. 19688 McGregor* (M).

### 12. AMYLOTHECA CRASSILIMBA (Merrill) Danser.

*Loranthus crassilimbus* MERR., Philip. Journ. Sci. § C 13 (1918) 274; Enum. Philip. Fl. Pl. 2 (1923) 103.

*Amylotheca crassilimba* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 300; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 36.

Omnis glabra. Ramuli robusti, internodiis junioribus teretibus nodis dilatatis non incrassatis, folia adulta ferentibus 2.5 ad 7 cm longis, 4 ad 7 crassis, vetustioribus nodis incrassationibus validis inflorescentias ferentibus. Folia opposita; petiolus supra plana vel leviter convexa, subtus valde convexa, marginibus acutis non alatis, 20 ad 30 mm longus, 3 ad 4.5 mm latus; lamina oblonga ad ovato-oblonga, rarius ovata vel lanceolata, maxima latitudine paulum sub medio, 10 ad 20 cm longa, 2.5 ad 10 cm lata, basi rotundata vel cuneata paulum in petiolum contracta, margine regularis et integer, apice obtusiuscula crasse coriacea, faciebus valde diversis, (in herbario) superiore viridi inferiore rufa, regulariter penninervis, costa supra subdistincta subtus valde prominente, nervis lateralibus utrinque vix visibilibus. Inflorescentiae racemi triadum flore medio sessili floribus lateralibus breviter pedicellatis vel sessilibus, in nodis iam defoliatis insertae, raro etiam in axillis foliorum vetustissimorum, basi scrobiculo corticis circumdatae superea involucro ex paucis paribus bractearum triangularium saepe ad 2.5 raro ad 6 mm longarum composito saepe mox deciduo; axis teres nodis paulum applanatis, 3 ad 6.5 cm longus, supra basin incrassatam 2 ad 4 mm crassus apicem versus attenuatus fere a basi dense florifer, paribus florum ad 9; pedicelli triadum 3 ad 5 mm longi 1.25 mm crassi basi et apice vix incrassati; pedicelli florum lateralium 0 ad 2 mm longi c. 1 mm crassi; bracteae deciduae, reniformes vel breve triangulares, ad 2 mm longae, margine albido irregulariter lacerato. Calicis tubus ellipsoides, basi et infra limbum paulum contractus, 3 ad 4 mm longus, medio 1.5 ad 1.75 mm latus; limbus c. 0.75 mm longus, patens, margine albido distincte obtuseque lobatus vel irregulariter laceratus. Corolla statu alabastri adulti 22 ad 33 mm longa, subcylindrica, supra basin paulum dilatata ad 3 vel 4 mm lata, deinde attenuata ad 2 mm crassitudine, c. 5 ad 7 mm ad apice incrassata, ceterum cylindrica apice obtusissima, postea usque ad basin partita in petala 6 linearia basin versus paulum dilatata 1 ad 2 mm lata, sursum paulum attenuata, 5 ad 7 mm superioribus reflexis paulo latioribus, ad 0.75 mm latis, apice obtusiusculis. Filamenti pars libera 0 ad 1.5 mm longa; anthera 3.5 ad 5 mm longa, basi facie inferiore appendice parva, apicem versus sensim attenuata, acutissima, loculis 4 continuis. Stylus 22 ad 33 mm longus, 6-angularis, tenuis, 5 ad 6 mm superioribus paulo crasior sulcis 12, supra discum articulatus. Fructus ellipsoides, ad 10 mm longus, 7 mm crassus, sub calicis limbo permanente contractus.

The peculiar combination of characters presented by this species is discussed at the beginning of the section on this genus. Most peculiar are the deciduous bracts and the wholly choripetalous corolla. An involucre as we find at the base of the inflorescences is also found at the base of each twig beginning its growth after a period of rest. The flowers are described on the labels as red and yellow; red, yellow, and green; or entirely yellow, the commonest flower colors in *Amylotheca.*

LUZON, frontier between Nueva Vizcaya and Pangasinan, 1,200 to 1,400 m altitudes, *F. B. 15860 Merritt* (M): Nueva Ecija Province, Mount Umingan, 300 m elevation, *Bur. Sci. 26409 Ramos and Edaño* (M, type of *Loranthus crassilimbus*): Rizal Province, *Loher 13897* (M, UC); Montalban, *Loher s. n.* (UC); Panauisan, *Loher 12434* (M, UC); Mount Lumutan, 300 m elevation, *Bur. Sci. 29654 Ramos and Edaño* (M); Mount Irig, 900 m elevation, *Bur. Sci. 41959 Ramos* (M, B, L, Be); Mount Irid, 750 m elevation, *Bur. Sci. 48495 Ramos and Edaño* (UC, NY, B): Camarines Sur Province, Mount Potianay, summit, 900 m elevation, *Bur. Sci. 75933* and *76023 Edaño* (M, NY).

PANAY, Capiz Province, Mount Madiaas, 355 m elevation, *Bur. Sci. 30724 Ramos and Edaño* (M, B, L, Be).

**13. AMYLOTHECA OVATIFOLIA (Merrill) Danser.**

*Loranthus ovatifolius* MERR., Philip. Journ. Sci. § C 3 (1908) 133; 4 (1909) 143; Enum. Philip. Fl. Pl. 2 (1923) 107; excl. specim.

*Amylotheca ovatifolia* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 302; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 38.

Omnis glabra. Ramuli graciles, internodiis teretibus, junioribus nodis incrassatis dilatatis, folia adulta ferentibus 1.5 ad 5.5 cm longis, 1 ad 2 mm crassis. Folia opposita; petiolus supra basin paulum incrassatam teres supra sulcatus, 3 ad 5 mm longus, 0.75 ad 1.5 mm crassus; lamina crasse vel tenuiter coriacea, subfragilis, ovato-cordata ad ovato-lanceolata, 3 ad 8 cm longa, 1 ad 5.5 cm lata, ramorum apices floriferos versus sensim minor, faciebus valde diversis, basi cordata vel rotundata raro cuneata, margine regularis et integra nonnunquam paulum revoluta, apicem obtusum versus paulum acuminata, facie superiore costa plana vel impressa sed distincta nervis lateralibus et venis indistinctis, facie inferiore costa valde prominente nervis lateralibus paulo magis visibilibus quam facie superiore. Inflorescentiae singulae in axillis foliorum lateralium vel etiam sequentium, racemi triadum flore medio sessili lateralibus pedicellatis, basi involucre ex paucis paribus bractearum breviter triangularium parte apicali obtuse carinatarum composito, quarum interiores c. 1.5 mm longae exteriores breviores. Axis 5 ad 10 mm, tantum longus basi 1 ad 1.25 mm crassus, teres, nodis paulum applanatus apicem versus paulum attenuatus, dimidia parte inferiore nudus superiore paribus 3 ad 4 triadum; pedicelli triadum teretes 1.5 ad 3 mm longi 0.5 ad 0.75 mm crassi, apice paulum incrassati; pedicelli florum lateralium 1.25 ad 1.5 mm longi, c. 0.5 mm crassi; bractea floris medii ovata semiamplexicaulis acuta, parte apicali magis albida et obtuse carinata, c. 1.25 ad 1.75 mm longa; bracteae florum lateralium paulo minores et parte apicali minus diversa. Calicis tubus cylindricus c. 1.5 mm longus; limbus 0.5 mm longus integer. Corolla statu alabastri 20 ad 23 mm longa, subcylindrica, parte inferiore vix superiore paulum dilatata, basi c. 1 ad 1.5 mm lata, medio paulo angustior, apice obtusa vel subacuta, postea partita in lacinias 5 c. 0.3 mm latas, 5 mm ab apice reflexas, parte superiore angusta spathulata, tubum 3 ad 6 mm longum relinquens. Stamina 5; filamenti pars libera c. 2 mm longa; anthera c. 1.5 mm longa, oblonga, obtusa, mucronulata, loculis 4. Stylus 20 ad 23 mm longus, filiformis, stigma versus paulum crassior; stigma stylo paulo crassius, obtusum. Fructus ignotus.

*Amylotheca ovatifolia*, though closely related to *A. saccata* and *A. Aherniana*, has certainly 5-merous flowers. The flowers are said to be scarlet or red.

BOHOL, Bilar, 600 m elevation, *Bur. Sci. 43123 Ramos* (M, UC) and *43262 Ramos* (M, UC, Be). MINDANAO, sea coast between Iligan and Initao, *Clemens 1195* (M, type, Be, cotype of *Loranthus ovatifolius* Merr.).

### 14. AMYLOTHECA SACCATA (Elmer) Danser.

*Loranthus saccatus* ELMER, Leaf. Philip. Bot. 3 (1911) 1072; MERR., Enum. Philip. Fl. Pl. 2 (1923) 109.

*Loranthus lucidus* MERR., Philip. Journ. Sci. § C 9 (1914) 277; LECOMTE, Not. syst. 3 (1915) 175; MERR., Enum. Philip. Fl. Pl. 2 (1923) 106.

*Loranthus cordilimbus* MERR., Philip. Journ. Sci. 30 (1926) 391.

*Amylotheca saccata* and *cordilimba* DANS., Bull. Jard. Buitenzorg III 10 (1929) 300, 302; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 36, 38.

Glabra, inflorescentiis nonnunquam minute leprosulis et floribus junioribus nonnunquam dense puberulis exceptis. Ramuli plerumque graciles, internodiis apice applanatis et folia versus incrassatis, folia adulta ferentibus 2 ad 9 cm longis, 1.5 ad 3.5 mm crassis. Folia opposita vel subopposita; petiolus basi paulum incrassatus ceterum teres supra canaliculatus, 3 ad 12 mm longus, 0.6 ad 3 mm crassus; lamina tenuiter coriacea, subfragilis, ovata ad ovato-lanceolata, plerumque 5 ad 21 cm longa, 1.5 ad 9 cm lata, apices ramorum floriferos versus sensim minor, basi cordata vel rotundata vel cuneata, margine regularis et integra, plana vel leviter revoluta, apicem acutum versus longe acuminata, faciebus valde diversis, penninervis, nervis lateralibus oblique incurvatis, facie superiore costa subplana nervis lateralibus venisque paulum prominentibus, facie inferiore costa valde prominente nervis lateralibus venisque saepe distinctioribus. Inflorescentiae singulae vel binae (raro ternae?) in axillis foliorum terminalium vel etiam 1 vel 2 parium sequentium, racemi triadum floribus mediis sessilibus lateralibus pedicellatis, basi margine scrobiculi corticis necnon involucre 3 ad 6 parium decussatorum bractearum triangularium acutarum vel acuminatarum, quarum interiores c. 3 mm longae, obtuse, carinatae, exteriores minores; axis fere a basi florifer, paribus 6 ad 16 triadum decussatis, teres nodis applanatis, 4 ad 7 cm longus, supra basin 1 ad 2.25 mm crassam sensim attenuatus; pedicelli plerumque 3 ad 6 mm longi c. 0.75 ad 1.25 mm crassi; pedicelli florum lateralium c. 2.5 ad 3.5 mm longi, 0.5 ad 0.75 mm crassi; bracteae florum mediorum ovatae acutae parte superiore magis albidae et plerumque obtuse carinatae, semiamplexicaules, 2.5 ad 3.5 mm longae; bracteolae florum lateralium paulo minores et obtusiores et parte superiore minus diversa. Calicis tubus subcylindricus, 2 ad 2.5 mm longus, 1.25 ad 1.5 mm latus; limbus 0.3 ad 0.5 mm longus, subinfundibuliformis integer. Corolla statu alabastri adulti 14 ad 18 mm longa, quarta parte inferiore ad 3 mm inflata, basi rotundata sursum sensim attenuata, parte media cylindrica 1 mm lata, quinta parte superiore 3.5 ad 4 mm longa, 6-angularis breve ellipsoides subglobosus c. 2.5 mm lata, postea profunde partita in lacinias 6 e basi 1.5 mm lata sensim attenuatas in partem mediam 0.3 mm latam deinde in partem apicalem oblongam 0.75 ad 1 mm latam 3 mm longam obtusam dilitatas 6 mm ab apice reflexas, tubum 1 ad 2 mm longum relinquens. Stamina 6; filamenti pars libera c. 2.5 ad 3.5 mm longa; anthera oblonga, apice basique obtusa c. 1.5 mm longa 0.5 mm lata loculis 4 continuis. Stylus 14 ad 18 mm longus, c. 0.25 mm crassus prope stigma paulo crassior, ad basin articulatus; stigma sublobosum obtusissimum styli apice c. sesquiplo crassius. Fructus ellipsoides vel subpiriformis, maximi ad 7 mm longi, 5 mm crassi.

Elmer, in his original description, gives the corolla and style as 25 mm long, whereas in reality the length is 15 to 19 mm. Hence Merrill's belief that his *Loranthus lucidus* was a different species. Though the type specimen of *Loranthus lucidus* shows several differences from *Amylotheca saccata,* these differences are of too little value to keep *Loranthus lucidus* apart as a species.

*Amylotheca saccata* occurs from low altitudes to 1,200 m elevation. The flowers are called white or red on herbarium labels, the fruit white.

LUZON, Cagayan Province, Pinagsongayan River, 390 m, *Bur. Sci. 78549 Edaño* (M): Rizal Province, *Loher 12578* (M, UC): Laguna Province, San Antonio (Dahican River), *Bur. Sci. 16647 Ramos* (M, type, L, Be, cotypes of *Loranthus lucidus* Merr.): Camarines Sur Province, Mount Isarog, 1,200 m, *Bur. Sci. 76281 Edaño* (M, NY). SAMAR, Loquilocon, *Bur. Sci. 43873 McGregor* (M, type, NY, UC, cotypes of *Loranthus cordilimbus* Merr.). PANAY, Capiz Province, Jamindan, San Juan, 74 m elevation, *Bur. Sci. 31026 Ramos and Edaño* (M, B, Be). DINAGAT, low altitude, *Bur. Sci. 83804 Ramos and Convocar* (M); 3 m elevation, *Bur. Sci. 84094 Ramos and Convocar* (M). MINDANAO, Davao Province, Mount Apo, Todaya, 1,200 m elevation, *Elmer 11747* (M, B, L, U, NY, Be, cotypes of *Loranthus saccatus* Elm.).

15. **AMYLOTHECA AHERNIANA** (Merrill) Danser.

*Loranthus ahernianus* MERR., Philip. Journ. Sci. 1 Suppl. (1906) 184; § C 4 (1909) 143; LECOMTE, Not. Syst. 3 (1914) 175; MERR., Enum. Philip. Fl. Pl. 2 (1923) 102.

*Loranthus acuminatissimus* MERR., Philip. Journ. Sci. § C 4 (1909) 143; Enum. Philip. Fl. Pl. 2 (1923) 102.

*Amylotheca Aherniana* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 300; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 35.

Omnis glabra, pedunculis pedicellisque nonnunquam tenuiter leprosulis exceptis. Ramuli subgraciles, teretes; internodia apice dilatata et ad insertiones foliorum incrassata, internodia folia ferentia 2 ad 5 mm crassa, 2 ad 5 cm longa, vetustiora incrassationibus majoribus inflorescentias ferentibus. Folia opposita vel subopposita; petiolus supra basin vix incrassatam teres, laminam versus supra leviter applanatus vel subcanaliculatus, 4 ad 14 mm longus, 1 ad 2.5 mm latus, haud alatus; lamina crasse vel tenuiter coriacea, subfragilis, ovata ad ovato-lanceolata, plerumque 5 ad 13 cm longa, 1.5 ad 4.5 cm lata, apices ramorum versus sensim minor, basi rotundata vel cuneata, margine integro vix revoluto, apicem subacutum versus magis vel minus acuminata, faciebus valde diversis, penninervis, sed nervis lateralibus inferioribus saepe approximatis valde incurvatis, ergo basi triplinervi vel quintuplinervi, facie superiore costa leviter prominente nervis lateralibus venisque distinctis, facie inferiore etiam nervis omnibus distinctis sed costa magis prominente. Inflorescentiae racemi triadum flore medio sessili lateralibus pedicellatis, singulae vel binae in axillis foliorum terminalium vel etiam parium nunnullorum sequentium, basi margine lacerato scrobiculi corticis et involucro parium decussatorum 3 ad 6 bractearum triangularium obtuse carinatarum subacutarum, quarum interiores 3 ad 4 mm longae exteriores sensim breviores; axis partibus 0.3 ad 0.75 superioribus paria 2 ad 6 triadum decussata ferens, infra saepe incrassationibus parvis decussatis, teres vel angulatus, 2.5 ad 7 cm longus, 1 ad 1.25 mm crassus, apicem versus paulum attenuatus; pedicelli triadum plerumque 5 ad 12 mm longi, c. 0.75 mm crassi, apice paulo crassiores; pedicelli florum lateralium c. 3 ad 8 mm longi, 0.5 ad 0.75 mm crassi; bracteae florum mediorum ovato-rhombeae simiamplexicaulis, parte superiore albidae obtuse carinatae, apice acutae vel acuminatae, 2.5 ad 3.5 mm longae; bracteolae florum lateralium rotundato-ovatae, plerumque obtusissimae, c. 1.5 ad 2 mm longae, ecarinateae sed parte superiore albidae. Calicis tubus cylindricus basi rotundatus, limbus cupuliformis vel subinfundibuliformis, integer vel leviter 6-lobatus, crassus, margine tenui, calix omnis 2.5 ad 3 mm longus, medio 1.5 ad 1.75 mm latus. Corolla 23 ad 32 mm longa, statu alabastri adulti in 5 ad 8 mm inferioribus inflata basi rotundata sursum sensim attenuata, deinde subcylindrica, parte superiore abrupte in clavam ellipsoidem obtusissimam 4 ad 6 mm longam, 2 ad 2.5 mm latam incrassata, postea in petala 6 omnino libera partita vel in lacinias 6 basi in tubum 3 ad 5 mm longum unitas dehiscens, petalis vel laciniis e basi c. 1 mm lata attenuatis deinde lineararibus c. 0.5 mm latis, parte superiore anguste spathulatis c. 0.75 mm latis obtusis, dimidia longitudine reflexis. Stamina 6; filamenti pars libera 8 ad 9 mm longa; anthera linearis basi cuneata apice obtusissima, 3 ad 5 mm longa, 0.5 mm lata, loculis 4 continuis. Stylus 23 ad 32 mm longus, filiformis, ima basi articulatus, stigma et basin versus paulo crassior; stigma globosa, styli apice sesquiplo crassius. Fructus ignotus.

*Loranthus acuminatissimus* Merr. cannot be kept separate as a species from *L. ahernianus* Merr., as it only differs from the latter by the entirely glabrous inflorescences and slightly different leaf shape. More different are *F. B. 8991* and *F. B. 6944* by having narrower, stronger-nerved leaves, the former, moreover, by quite choripetalous corollas, whereas the latter has no flowers. *Loranthus ahernianus* and *L. acuminatissimus* also are described by Merrill as sympetalous. If later collections prove that *Amylotheca Aherniana* really is sympetalous, there will be reason to base a new species on the two numbers mentioned.

The herbarium labels describe the color of the corollas as yellow.

LUZON, Mountain Province, Benguet, Baguio, Sablang River, *Bur. Sci. 5700 Ramos* (M, type, Be, cotype of *Loranthus acuminatissimus* Merr.): Zambales Province, Bapotao, *Bur. Sci. 5115 Ramos* (M); Bacao, *F. B. 6944 Curran* (M); *F. B. 8991 Curran* (M, NY); Anuling, low altitude, *Bur. Sci. 44565 Ramos and*

*Edaño* (M, NY, UC): Rizal Province, Bosoboso, *F. B. 2140 Ahern's collector* (M, type, NY, B, S, Be, cotypes of *Loranthus ahernianus* Merr.).

16. **AMYLOTHECA VIRIDIS** (Merrill) Danser.

*Loranthus viridis* MERR., Philip. Journ. Sci. 1 Suppl. (1906) 189; § C 4 (1909) 145; Enum. Philip. Fl. Pl. 2 (1923) 111.

*Loranthus pachycladus* MERR., Philip. Journ. Sci. § C 13 (1918) 1918; Enum. Philip. Fl. Pl. 2 (1923) 107.

*Amylotheca viridis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 303; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 39.

Omnis glabra. Ramuli robusti, internodiis non bene distinctis, folia adulta ferentibus primum teretibus nodis paulum applanatis et foliorum insertionibus incrassatis, postea minus applanatis foliorum insertionibus in costam obtusam decurrentibus, 4- ad 6-angularibus, 6 ad 10 mm crassis. Folia opposita vel subopposita vel rarius ternata, petiolus supra basin paulum incrassatam subteres, laminam versus applanatus, dilatatus, prope laminam supra subtusque convexus marginibus subalatis, 15 ad 35 mm longus, prope basin 1.5 ad 3.5 mm crassus; lamina crassea coriacea, plana, faciebus valde diversis, 6 ad 12 cm longa, 2.5 ad 6 cm lata, breve elliptica ad oblongo-lanceolata, maxima latitudine plerumque circa medium, basi obtusa vel magis minusve acuta, semper paulum in petiolum attenuata, apicem obtusum versus plerumque leviter acuminata, margine integro distincte revoluto, facie superiore semilucida vel opaca saepe subglauca, costa leviter convexa sed distincta nervis lateralibus indistinctis, facie inferiore opaca saepe badiuscula, costa valde prominente nervis lateralibus valde indistinctis saepe invisibilibus. Inflorescentiae umbellae triadum floribus mediis sessilibus lateralibus pedicellatis, plerumque solitariae in axillis foliorum terminalium et parium 1 vel 2 sequentium, basi margine scrobiculi corticis circumdatae sed involucro carentes; pedunculus cylindricus basi et insertionibus triadum incrassatis, 28 ad 35 mm longus, 2 ad 3.5 mm crassus; pedicelli triadum plerumque 4 ad 6 in apice pedunculi distincte decussati, nonnunquam pari singulo remoto, teretes, 12 ad 17 mm longi, 1.5 ad 2.5 mm crassi, basi apiceque incrassati; pedicelli florum lateralium teretes, 4 ad 8 mm longi, basi subincrassati; bracteae ovatae amplexicaules obtusae, 2.5 ad 4 mm longae, basin versus crassiusculae. Calicis subcylindricus, tertia parte superiore magis minusve infundibuliformis, omnis 5 ad 7 (5 ad 6) mm longus, 3 ad 3.5 (2 ad 2.5) mm latus, limbo 1 ad 1.5 mm longo, integro vel sublobato. Corolla sympetala 30 ad 47 (30 ad 40) mm longa, statu alabastri adulti supra partem basalem cylindricam c. 1 mm longam, 2 ad 3 mm latam in partem ellipsoidem quartam partem totius corollae longam ad 5 ad 7 mm inflata, deinde sensim in partem mediam 6-angularem 2.5 ad 3 (2 ad 2.5) mm latam attenuata, denique in clavam apicalem 6-angularen obtusissimam incrassata, postea in lacinias 6 partita, tubum plerumque 4 ad 7 mm longus relinquens, laciniis e basi 2.5 mm lata sensim ad 0.75 mm attenuatis deinde in partem apicalem spathuliformen 2 ad 2.5 (1.25 ad 1.5) mm latam obtusam crassam (sectione transversa quadriangulam) attenuatis supra insertiones filamentorum reflexis vel nonnihil volutis. Filamenti pars connata prominens, pars libera c. 5 mm longa, in excavatione petali quadrans; anthera obtusa 6 mm longa, 0.5 mm lata, loculis 4 continuis. Stylus 30 ad 47 (30 ad 40) mm longus, supra basin articulatus, papillam 1 ad 1.5 mm longam in fructu relinquens, c. 0.5 mm crassus sed in 10 ad 15 mm superioribus sensim ad 0.75 mm incrassatus; stigma capitatum obtusissimum, styli apice vix crassius. Fructus ellipsoides vel breve piriformis; ad 18 mm longus, 15 mm crassus; endospermum obpiriforme, ad 5 mm longum 4 mm crassum.

As the dimensions of carnose or coriaceous flowers, like those of *A. viridis*, are rather different in the dried and in the fresh state, I have added, between brackets, after the dimensions of the parts soaked in water, those of the same parts dried.

The flowers of *A. viridis* are said on the herbarium labels to have a green or yellowish green corolla. The species occurs from low altitudes to 650 m above sea level.

Philippine Islands, *Cuming 1953* (M). LUZON, Ilocos Norte Province, Burgos, 44 m elevation, *Bur. Sci. 27323 Ramos* (M, type, L, NY, cotypes of *Loranthus pachycladus* Merr.), low altitude, *Bur. Sci. 32836 Ramos* (M): Zambales Province, Baliucaguan, *Warburg 13326* (Be): Bataan Province, Lamao River, Mount Mariveles, 600 m elevation, *F. B. 816 Borden* (M, type, NY, B, Be, cotypes of *Loranthus viridis* Merr.), 650 m elevation, *F. B. 1814 Borden* (M, Be), 200 m, *F. B. 2938 Borden* (M, UC, B, S, Be); Lamao Forest Reserve, *F. B. 6318 Curran* (M, NY, B): Rizal Province, *Loher 14896* (M, UC); Montalban, *Loher 13363* (M, UC); Balacbac, *Loher 14939* (M).

17. **AMYLOTHECA PENTAGONA** (Merrill) Danser.

*Loranthus pentagonus* MERR., Philip. Journ. Sci. § C 7 (1912) 80; Enum. Philip. Fl. Pl. 2 (1923) 108.

*Amylotheca pentegona* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 302; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 38.

Omnis glabra. Ramuli robusti, internodiis indistinctis, folia adulta ferentibus costis 5 valde prominentibus subacutis, ex insertionibus foliorum utrinque decurrentibus, lateribus subconcavis separatis, insertionibus foliorum paulum incrassatis, 6 ad 8 mm crassis. Folia sparsa vel magis minusve decussata vel ternata; petiolus 10 ad 20 mm longus, supra basin subincrassatam teres 1.5 ad 3 mm crassus, laminam versus sensim applanatus marginibus subalatis; lamina faciebus valde diversis, coriacea, elliptica vel oblonga, maxima latitudine in vel paulum sub medio, basi rotundata vel cuneata, apicem obtusum versus breve acuminata, margine revoluta, facie superiore subglauca opaca, costa distincta paulum prominente, nervis lateralibus subdistinctis venis invisibilibus, facie superiore badiuscula opaca, costa praecipue basin versus valde prominente nervis lateralibus distinctioribus venis partim visibilibus. Inflorescentiae racemi triadum partim sparsarum partim decussatarum, floribus mediis sessilibus lateralibus pedicellatis, singulae in axillis foliorum superiorum, raro etiam vere terminales; axis basi margine lacerato scrobiculi corticis circumdatus sed involucro bractearum carens, basi subincrassatus, 30 ad 50 mm longus, parte inferiore et media 3 ad 5 mm crassus, apicem versus paulum attenuatus, costis ex insectionibus triadum decurrentibus angulatus; pedicelli triadum basi apiceque subincrassati, 8 ad 10 mm longi, 2 ad 3 mm crassi; pedicelli florum lateralium c. 3 mm longi, basi 2 apice 3 mm crassi; bracteae suborbiculari-cordatae, obtusae, c. 3 mm longae, basi crassiusculae. Calicis subcylindricus, basi rotundatus, 6.5 ad 7.5 (5.5 ad 6.5) mm longus, 4 ad 4.4.5 (3.5 ad 4.5) mm latus, limbo c. 1.5 mm longo erecto vel paulum infundibuliformi, integro vel sublobato. Corolla 40 ad 45 mm longa, statu alabastri adulti supra partem basalem cylindricam 1 mm longam, 2.5 ad 3.5 mm latam in tertiam partem totius corollae 6 ad 7 (5 ad 6) mm latam inflata, deinde in tertiam partem mediam 6-angularem 3 ad 3.5 (2.5 ad 3) mm latam angustata, denique in clavam apicalem 6-angularem obtusam 4 ad 5 (3 ad 3.5) mm crassam incrassata, postae dehiscens in lacinias 6 e basi 2.5 (1.25) mm lata sensim ad 1 mm attenuatas parte apicali anguste-spathulatas c. 2 (1.25) mm latas obtusas crassas (sectione transversa quadriangulas), parte supra insertiones filamentorum reflexas vel etiam paulum convolutae, basi in tubum c. 10 mm longum cohaerentes. Filamenti pars libera c. 2.5 mm longa; anthera 6 ad 8 mm longa, loculis 4 continuis. Stylus 40 ad 45 mm longus, supra basin articulatus, papillam 6-angularem brevem in fructu relinquens, 0.3 ad 0.5 mm crassus, in c. 13 mm superioribus sensim ad 0.6 mm incrassatus; stigma ellipsoides, c. 0.75 mm longum, 0.6 mm crassum. Fructus ignotus.

As in the description of *A. viridis,* I have given for the fleshy flowers of this species, after the dimensions of the flowers soaked in water, those of the flowers dried.

*Amylotheca pentagona* is closely related to *A. viridis;* it differs from the latter species chiefly by the triads racemosely arranged on the axis of the inflorescence and by the shorter pedicels of the triads and of the lateral flowers, but there are several less important differences, such as the smaller corolla with longer tube.

LUZON, Bontoc Subprovince, Bauco, 1,650 m, *Vanoverbergh 1254* (M, type, Be, cotype of *Loranthus pentagonus* Merr.), flowers yellowish.

### II. Genus LEPEOSTEGERES Blume

*Lepeostegeres* (*Lepeosteogeres, Lepostegeres*) BLUME, in Schultes, Syst. 7 2 (1830) 1611, 1731; Fl. Javae Lor. (1830) 10; MIQ., Fl. Ind. Bat. 1 1 (1856) 833; VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 143, 268; 42 (1895) 445, 449; Compt. Rend. As. Sc. Paris 153 (1911) 1196, 1198; GAMBLE, Journ. As. Soc. Beng. 75 (1914) 381 p. p.; MERR., Enum. Philip. Fl. Pl. 2 (1923) 101; RIDLEY, Fl. Mal. Pen. 3 (1924) 163 p. p.; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 291, 320; 11 (1931) 258; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 62; Rec. Trav. Bot. Néerl. 30 (1933) 469, ic. 2*a*.

*Stegastrum* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1925) 447; Compt. Rend. Ac. Sc. Paris 153 (1911) 1196, 1198.

*Choristega, Choristegeres* VAN TIEGH., Compt. Rend. Ac. Sc. Paris 153 (1911) 1197, 1198.

Inflorescentia capitulum triadum, involucro e bracteis decussatis composito; bracteis interioribus triades exteriores ferentibus, bracteis ceteris et bracteolis florum lateralium nullis vel valde reductis, pedicellis nullis vel brevibus post anthesin prolongatis. Flores 6-meres, sympetali, regulares, corolla tubo brevi laciniis erectis supra insertiones staminum reflexis. Antherae basifixae, angustae, acutae, loculis 4 continuis. Stylus paulum supra basin articulatus, fructui rostrum breve relinquens.

In the Philippine Archipelago the genus *Lepeostegeres* is represented by one species, which is spread from northern Luzon to southern Mindanao. Outside the Philippines the genus is represented by nine species inhabiting the western part of the Malay Archipelago, from Celebes to Sumatra and Java, and including the Malay Peninsula. The Philippine species differs from all others by a receptacle and pedicels growing out after flowering, and by bracts soon falling off.

### 1. LEPEOSTEGERES CONGESTIFLORUS (Merrill) Merrill.

*Loranthus congestiflorus* MERR., Philip. Journ. Sci. § C 4 (1909) 147; MERR. and MERRITT, Philip. Journ. Sci. § C 5 (1910) 345; ELMER, Leafl. Philip. Bot. 3 (1911) 1076.

*Lepeostegeres congestiflorus* MERR., Enum. Philip. Fl. Pl. 2 (1923) 101; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 321; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 63; Rec. Trav. Bot. Néerl. 30 (1933) 466.

Omnis glabra. Ramuli subrobusti, internodiis junioribus teretibus apice paulum applanatis et dilatatis, folia adulta ferentibus 2.5 ad 5 mm crassis, 1.5 ad 4 cm longis, vetustioribus teretibus nodis magis minusve incrassatis. Folia opposita vel rarius subopposita; petiolus difficile a lamina distinguendus, basi subteres supra paulum applanatus, laminam versus supra magis applanatus, 8 ad 15 mm longus; lamina plerumque elliptica vel obovato-elliptica ad oblonga vel obovato-oblonga, 5 ad 10 cm longa, 2 ad 5 cm lata, basi cuneata vel attenuata, maxima latitudine plerumque paulum supra medium, apice obtusa vel rotundata, crassiuscule coriacea, utraque facie opaca, penninervis raro basi triplinervis, costa supra indistincta subtus valde prominente rotundata vel subcarinata, nervis lateralibus crassioribus supra indistinctis subtus plerumque invisibilibus. Inflorescentiae singulae in axillis foliorum vel in nodis iam defoliatis, omnino sessiles; receptaculum tempore florendi conicum basi 3 ad 4 mm crassum, 3 ad 6 mm longum, parte inferiore plerumque 4 ad 5 (raro 7) paribus bractearum decussatarum iam ante tempus florendi partim deciduarum, exterioribus parvis interioribus gradatim majoribus et oblongioribus, deinceps breve reniformibus suborbicularibus ellipticis ovalibus, interioribus 20 ad 25 mm longis 12 ad 18 mm latis, omnibus dorso convexo apice rotundato; flores 18 ad 30 in 3 ad 5 paribus triadum decussatis dispositi; pedicelli triadum brevissimi ad 2 mm lati, florum mediorum brevissimi, florum lateralium minus breves una cum pedicello triadis c. 2 mm longi; post anthesin pars receptaculi florifera prolongata ad 5 ad 8 mm longa, pedicelli florum mediorum brevissimi, lateralium ad 2 mm raro ad 4 mm longi. Calicis cylindricus vel pressione prismaticus, tubo 3 ad 3.5 mm longo, 1.25 ad 1.5 mm lato, limbo 0.25 ad 0.5 mm longo margine membranaceo integro vel irregulariter lacerato. Corolla statu alabastri adulti 23 ad 32 mm longa, supra basin ad 3 ad 4 mm dilatata dein sensim attenuata, ad tres quintas longitudinis c. 2 mm lata, parte apicali paulum incrassata, angularis, apicem obtusiusculum versus conice attenuata, postea in lacinias 6 dehiscens, tubum c. 2.5 mm longum relinquens; laciniae e basi c. 1 ad 1.25 mm lata sensim dimidiam longitudinem versus ad 0.5 mm attenuata, parte superiore c. 8 mm longa reflexae angustissime lanceolatae, apice crassiusculae et cucullatae. Filamenti pars libera 1 ad 1.75 mm longa; anthera 4 ad 5 mm longa, linearis, acuta, loculis 4 continuis, petalis c. 1 mm brevioribus. Stylus denique corolla 3 ad 4 mm longior, c. 0.5 mm supra basin articulatus, stigma versus sensim attenuatus; stigma subglobosum, c. 0.25 mm crassum. Fructus ellipsoides, quoad notus ad 7 mm longus 5 mm crassus, styli basi et calicis limbo paulum incrassato coronatus.

The specimens of *Lepeostegeres congestiflorus* from Luzon usually have the corollas hardly 30 mm long, and the involucral bracts in four or more, rarely in five pairs; the specimens from the southern islands have the corollas nearly 32 mm long and the involucral bracts often in six, sometimes even in seven pairs. In other features this species is rather uniform. It is endemic in the Philippines and occurs from northern Luzon to southern Mindanao. The color of the corolla is indicated on herbarium labels as greenish white, greenish yellow, or yellow.

LUZON, Mountain Province, Bontoc, *Vanoverbergh 1294* (G, L, U, Br, Be, distributed as cotypes of *Lepidaria tetrantha,* the type of which bears the same number): Lepanto Subprovince, Mount Data and vicinity, *Clemens 17792a* (UC); Mount Data, 2,250 m, *Bur. Sci. 40299 Ramos and Edaño* (M, UC, B, L): Benguet Subprovince, *Loher 4459* (M); Mount Ugo, *Bur. Sci. 5780 Ramos* (M, NY); Mount Pulog, mossy forest, *Merrill 6597* (M), *Bur. Sci. 8833 McGregor* (M, B), *Bur. Sci. 8888 McGregor* (M, NY, B, Be), 2,400 m, *Bur. Sci. 45013 Ramos and Edaño* (UC, NY, S), 2,700 m, *Bur. Sci. 44968, 45026 Ramos and Edaño* (M, NY, UC), hardwood forest, 2,400 m, *F. B. 18084 Curran,*

*Merritt, and Zschokke* (M, L), 2,700 m, *F. B. 18045 Curran, Merritt, and Zschokke* (M); Mount Santo Tomas, hardwood forest, 2,400 m, *F. B. 14183 Merritt* (M); Mount Tonglon, top, *F. B. 5037 Curran* (M), type of *Loranthus congestiflorus;* Mount Santo Tomas, *F. B. 11093 Whitford* (M), *McClure 16009* (M, UC), *Williams, 1343 bis* (NY), 2,100 m, *Williams 1344* (NY), top forest, *F. B. 10833 Curran* (M). MINDORO, Mount Halcon, 1,650 m elevation, *F. B. 4434 Merritt* (M). NEGROS, Canlaon Volcano, *Merrill 221* (M, U, Br). MINDANAO, Bukidnon Province, Mount Lipa, *Bur. Sci. 38539 Ramos and Edaño* (L): Davao Province, Mount Apo, Todaya, 2,500 m elevation, *Elmer 10634* (M, NY, B, U, L): Misamis Province, Mount Malindang (Mount Bliss), 1,700 m elevation, *F. B. 4769 Mearns and Hutchinson* (M).

## III. Genus CYNE Danser

*Cyne* DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 291, 306; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 **29** 6 (1933) 42; Rec. Trav. Bot. Néerl. **30** (1933) 470, ic. 2*b*.

Inflorescentia capitulum triadum, involucro calyptrato, deciduo vel irregulariter dehiscente, triadibus decussatis, floribus omnino sessilibus, bracteis bracteolisque bene evolutis. Corolla 6-meres, sympetala, tubo brevi; antherae basifixa, acutae, loculis 4 continuis.

The genus *Cyne* is endemic in the Philippines and is spread from central Luzon to southern Mindanao. Four species have been distinguished.

### *Key to the species of Cyne.*

1. Young twigs quadrangular.......................................... 4. *C. quadriangula.*
   Young twigs terete ................................................................................ 2.
2. Coarse in all parts; leaves coriaceous, their petioles 2.5 to 5 mm broad, their fine veins invisible; twigs bearing full-grown leaves 3 to 5 mm thick; corolla 17 to 20 mm long.................................. 1. *C. banahaensis.*
   Not coarse; leaves thin-coriaceous to chartaceous, their petioles 1 to 2 mm broad, their finer veins distinct; twigs bearing full-grown leaves 1.5 to 3 mm thick; corolla 13 to 16 mm long............ 2. *C. alternifolia.*
   Compare also 3. *C. capitulifera,* with the young twigs cinnamomeous-furfuraceous.

### 1. CYNE BANAHAENSIS (Elmer) Danser.

*Loranthus banahaensis* ELMER, Leafl. Philip. Bot. **1** (1908) 288; MERR., Philip. Journ. Sci. § C **4** (1909) 145.

*Loranthus lagunensis* MERR., Philip. Journ. Sci. § C **9** (1914) 281.

*Lepeostegeres banahaensis* MERR., Enum. Philip. Fl. Pl. **2** (1923) 101 excl. specim.

*Cyne banahaensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 306; Verh. Kon. Akad. Wetensch., Amsterdam afd. Natuurk. § 2 29 6 (1933) 43.

Omnis glabra. Ramuli robusti, internodiis junioribus teretibus, primo juventute paulum applanatis et incrassatis, postea apicem et basin versus incrassatis duplo crassioribus quam medio, folia adulta ferentibus 1.5 ad 9 cm longis, 3 ad 5 mm crassis, iam ante folia decidentia cortice rugoso et lenticelloso (non leproso nec cinnammeo) postea cicatricibus magnis rotundis foliorum et inflorescentiarum. Folia opposita vel subopposita; petiolus difficile a lamina distinguendus et valde variabilis, supra planus subtus rotundatus, 2 ad 20 mm longus 2.5 ad 5 mm latus, basi vix incrassatus; lamina elliptica ad oblonga vel oblongo-obovata, 4 ad 17 cm longa, 2.5 ad 10 cm lata, basi plerumque cuneata vel in petiolum attenuata, apice obtusissima vel rotundata, crasse vel tenuiter coriacea, utraque facie opaca, inferiore magis rufa quam superiore, costa et margine subtus saepe obscure colorata, penninervis, costa supra leviter subtus valde prominente, nervis lateralibus crassioribus supra distinctis subtus indistinctis, venis utrinque invisibilibus. Inflorescentiae basi lata omnino sessiles, raro ramulo adpressae vel impressae, receptaculo non supra ramuli superficien elevato, primum singulae in foliorum axillis, postea etiam juxta illarum cicatrices utrinque procrescentes; involucrum denique ovatum; flores in 3 paribus triadum decussatis dispositi, omnino sessiles; bracteae bracteolaeque suborbiculares, crassiusculae, calicibus adpressae et circiter aequilongae, dorso convexo, bracteae triadum exteriorum c. 2 mm longae, 3 mm latae, interiorum 1.5 mm longae et latae, bracteolae triadum exteriorum 1.5 ad 2 mm longae 1.5 mm latae, interiorum 1.5 mm longae, 1 mm latae. Calicis campanulatus, pressione angulatus, c. 2 mm longus, 1.5 mm latus, limbo brevissimo irregulariter lacerato. Corolla statu alabastri adulti 17 ad 20 mm longa supra basin inflata ad 3 mm lata, deinde ad dimidiam longitudinem sensim attenuata ad 1.5 mm lata, ceterum cylindrica apice obtusa, postea tubo c. 4 mm longo, laciniis basi 1.25 mm latis sensim ad 0.5 mm attenuatis, parte reflexa 3 ad 4 mm longa 0.75 mm lata angusta lanceolata apice crassiuscula. Anthera sessilis, linearis, apicem acutum versus sensim attenuata, 3 mm longa, loculis 4 continuis. Stylus subaequicrassus, corollae aequilongus, paulum supra discum articulatus; stigma capitatum obtusissimum, stylo vix sesquiplo crassius. Fructus rotundato-ellipsoides, calicis limbo incrassato coronatus, maximus notus 8 mm longus, 5 mm latus.

Whereas the other species of *Cyne* are all indigenous to Mindanao, *C. banahaensis* is chiefly collected in Luzon, where it occurs at from 30 to 750 m elevation. The color of the corolla is indicated on the herbarium labels as yellow or yellow with red.

LUZON, Laguna Province, Dahican River, back of San Antonio, *Bur. Sci. 15064 Ramos* (M) type of *Loranthus lagunensis;* Mount Banahao, first camp, *Quisumbing 1259* (M): Tayabas Province, Umiray River, 30 m elevation, *Bur. Sci. 28966 Ramos and Edaño* (M); Mount Banahao, Lucban, 740 m, *Elmer 9115* (M, NY, B, L, U) cotypes of *Loranthus banahaensis.* MINDANAO, Surigao, iron deposit, 600 m, *Bur. Sci. 34590 Ramos and Pascasio* (M).

**2. CYNE ALTERNIFOLIA (Merrill) Danser.**

*Loranthus banahaensis* ELM., Leafl. Philip. Bot. 3 (1911) 1075; 6 (1913) 1960, non Leafl. 1 (1908).
*Loranthus alternifolius* MERR., Philip. Journ. Sci. § C 9 (1914) 283.
*Lepeostegeres alternifolius* MERR., Enum. Philip. Fl. Pl. 2 (1923) 101.
*Cyne alternifolia* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 306; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 42.

Omnis glabra. Ramuli graciles vel subrobusti, internodiis junioribus apicem versus applanatis et incrassatis, folia adulta ferentibus teretibus nodis magis incrassatis ad duplo crassioribus quam medio, 2 ad 6.5 cm longis, 1.5 ad 3 mm crassis, iam ante folia decidentia cortice rugoso, nec vero lenticellato nec leproso, postea cicatricibus magnis rotundis foliorum et inflorrescentiarum. Folia opposita vel rarius sparsa; petiolus difficile a lamina distinguendus, subtus valde supra leviter rotundatus, 1 ad 10 mm longus, 1 ad 2 mm latus, basi leviter incrassatus; lamina oblonga ad obovato-oblonga, rarius angustior, 5 ad 14 cm longa, 1.5 ad 5 cm lata, basi cuneata vel in petiolum attenuata, apice obtusissima vel rotundata, crassiuscule coriacea vel chartacea, utraque facie opaca vel sublucida, penninervis, costa supra leviter subtus valde prominente, nervis lateralibus crassioribus utrinque distinctioribus, venis partim visibilibus. Inflorescentiae basi lata omnino sessiles, saepe ramulo lateraliter adnatae denique cicatrices ovatas in ramulis relinquentes, receptaculo non supra ramuli superficiem elevato, primum singulae in axillis foliorum, postae etiam juxta illarum cicatrices utrinque procrescentes; involucrum denique ovatum vel globosum, ad 9 mm longum 7 mm diametro; flores in paribus triadum 3 decussatis, omnino sessiles; bracteae bracteolaeque suborbiculares crassiusculae, calicibus adpressae et subaequilongae, dorso convexo, bracteae exteriores 1 ad 1.5 mm longae 1.5 ad 2 mm latae, bracteolae exteriores 1 mm longae et latae. Calicis campanulatus pressione angulatus, 1.5 mm longus, 1 mm latus, limbo brevi irregulariter lacerato membranaceo. Corolla statu alabastri adulti 13 ad 16 mm longa, supra basin ad 3 mm inflata, apicem obtusissimum versus sensim attenuata, postea tubo companulato c. 3 mm longo, laciniis e basi sensim attenuatis usque ad partem apicalem reflexam c. 4 mm longam lanceolatum apice obtusam incrassatam. Anthera sessilis c. 3.5 mm longa a basi ad apicem sensim attenuata, acuta, loculis 4 continuis. Stylus a basi ad apicem subaequicrassus, corollae aequilongus, paululum supra basin articulatus, stigma capitatum obtusissimum, styli apice sesquiplo crassis. Fructus ignotus.

*Cyne alternifolia* is not very different from *C. banahaensis*, and is perhaps a form of that species. The materials seen by me admit a distinction between the two species, but in that case we must refer to *C. alternifolia* a few specimens that are placed under *C. banahaensis* by Elmer and Merrill.

*Cyne alternifolia* is only collected in Mindanao. The flower color is described as yellow in the lower part, red in the upper part.

MINDANAO, Agusan Province, Mount Urdaneta, Cabadbaran, in subalpine and alpine forests, *Elmer 14065* (M, NY, B, L): Davao Province, Mount Apo, Todaya, *Elmer 14079* (M, NY, B, L, U, Be): Zamboanga Province, opposite Olutanga Island, 30 m elevation, *F. B. 13295 Foxworthy, Demesa, and Villamil* (M, type, Be, cotype of *Loranthus alternifolius* Merr.).

### 3. CYNE CAPITULIFERA (Merrill) Danser.

*Loranthus capituliferus* MERR., Philip. Journ. Sci. § C 7 (1912) 264.
*Lepeostegeres capituliferus* MERR., Enum. Philip. Fl. Pl. 2 (1923) 101; (*-fer*) DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 321; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 62.
*Cyne capitulifera* DANS., Rec. Trav. Bot. Néerl. 30 (1933) 466.

Omnis glabra. Ramuli subrobusti, nodis paulum incrassatis, rugulosi et tenuiter cinnamomeo furfuracei, supra cicatrices foliorum cicatricibus magnis ovalibus capitulorum adnatorum;

internodia foliifera 3 ad 5 mm crassa. Folia opposita vel subopposita; petiolus basi teres, laminam versus supra sensim applanatus, difficile a lamina distinguendus, c. 6 ad 8 mm longus, 1.5 ad 2 mm latus; lamina oblonga vel oblongo-obovata, ad 12 cm longa, 5 cm lata plerumque minor, basi in petiolum attenuata, margine saepe irregulari, apice obtusissima vel rotundata, utraque facie opaca, crassiuscule coriacea, penninervis, costa supra plana distincta, subtus valde prominente, nervis lateralibus utrinque visibilibus non distinctis, venis invisibilibus. Inflorescentiae singulae in foliorum axillis, valde lateriter adnatae, cicatrices ovatas 10 ad 12 mm longas relinquentes; receptaculum planum non supra ramuli superficiem elevatum, 3 paria triadum decussata ferens; bracteae triadum exteriorum transverse ellipticae, c. 1 mm longae, 2.5 mm latae, bracteolae suborbiculares, c. 1 mm longae et latae, triadum interiorum minores. Calicis breve campanulatus, c. 2.25 mm longus, 2 mm latus, limbo brevissimo erecto paulum irregulariter dendato. Corolla statu alabastri adulti c. 18 mm longa, supra basin rotundatam c. 4 mm lata, versus duas tertias longitudinis sensim attenuata deinde cylindrica vel leviter coniformis 2 mm lata, post dehiscens in lacinias 6, tubo 4 ad 5 mm longo, laciniarum parte reflexa 3 ad 3.5 mm longa basi 1.5 mm lata apicem obtusissimum subcucullatum versus ad 0.75 mm attenuata. Anthera sessilis, c. 3 mm longa, a basi ad apicem acutum sensim attenuata. Stylus corolla 0.5 ad 1 mm longior, ima basi articulatus; stigma obtusissimum, styli apice aequicrassum. Fructus ignotus.

The materials of this species seen by me are very scanty and quite insufficient for a detailed description. The herbaria of Manila and Berlin each have one twig with a number of detached leaves; the Manila herbarium, moreover, has a receptacle with bracts and bracteoles attached to the twig, the Berlin herbarium a detached receptacle with bracts and bracteoles and four complete flowers. However, only the structure of the receptacle with the bracts and bracteoles is sufficient to show that this species is a *Cyne*. When Merrill describes the flowers as "quite enclosed by imbricated bracts" he must be in error, as the receptacle does not show, below the flowers, any scars of such bracts. Also Merrill underestimates, as in the other species of *Cyne*, the number of the flowers in the heads; the receptacles of this and other species clearly show three decussate pairs of triads; so the heads must have been 18-flowered, though probably less flowers were opened at the same time.

The materials are also sufficient to make it probable that *C. capitulifera* is specifically distinct from the other three species of this genus. From *C. quadriangula* it differs by the terete twigs; with *C. banahaensis* it agrees in the coarseness of the twigs and leaves, and the longer corolla; with *C. alternifolia* in the heads connate laterally with the adjacent internode; from both *C. banahaensis* and *C. alternifolia* it differs by the cinnamomeous, finely furfuraceous young twigs and the slightly thickened nodes.

MINDANAO, Zamboanga Province, Sax River, mountains back of San Ramon, 1,100 m elevation, *Merrill 8270* (M, type, Be, cotype of *Loranthus capituliferus* Merr.).

**4. CYNE QUADRIANGULA Danser sp. nov.**

Robusta, omnis glabra. Internodia folia adulta ferentia quadriangula, basi paulum applanata, apicem versus paulum dilatata et magis applanata, vetustiora teretescentia, 3 ad 5 mm longa, supra basin 3.5 ad 4 mm crassa, apice fere duplo latiora, lucida et laevia. Folia opposita; petiolus subtus magis convexa quam supra, difficile a lamina distinguendus, 6 ad 14 mm longus, medio c. 3 mm latus; lamina elliptica vel oblonga, saepe paulum obovata, 8 ad 14 cm longa, 3.5 ad 5 cm lata, e basi rotundata in petiolum contracta vel magis attenuata, apicem obtusiusculum versus breve acuminata, tenuiter coriacea fere chartacea, utraque facie opaca, penninervis, costa et nervis lateralibus crassioribus prominentibus, venis tenuioribus partim distinctis. Inflorescentiae in axillis foliorum singulae, etiam in nodis vetustioribus juxta cicatrices utrinque procrescentes, involucro ad 12 mm longo fere aequilato. Flores aperti ignoti. Cetera, quantum nota, ut in *C. banahaensi.*

This species differs from all others of its genus by its quadrangular shining young twigs and its acuminate leaves; with *C. banahaensis* it agrees by its coarseness, with *C. alternifolia* by its thinner leaves. Though open flowers are unknown, the materials extant appear sufficient to support a new species.

MINDANAO, Surigao Province, Bucas Grande Island, low altitude, *Bur. Sci. 35119 Ramos and Pascasio* (M) type, calyx green, petals chocolate color.

## IV. Genus THAUMASIANTHES Danser

*Thaumasianthes* DANS., Rec. Trav. Bot. Néerl. 30 (1933) 464, ic. 1, 2*d*.

Inflorescentia capitata, receptaculo prolongato, bracteis decussatis, triadem florum vel superioribus triadem diminutam ferentibus. Flores omnes sessiles, bractea 1 et bracteolis 2 suffultis. Corolla sympetala, 6-meres. Antherae basifixae acutae, loculis 4 continuis.

The genus *Thaumasianthes* is endemic in the Philippines, and has been collected only in Samar and Leyte.

*Key to the species of Thaumasianthes.*

1. Outer bracts of the inflorescence broader than long; bracts of the second and fourth pair slightly keeled towards the apex. 1. *T. amplifolia.*

Outer bracts of the inflorescence longer than broad; bracts of the first and second pair keeled over the whole length............ 2. *T. ovatibractea.*

**1. THAUMASIANTHES AMPLIFOLIA (Merrill) Danser.**

*Loranthus amplifolius* MERR., Philip. Journn. Sci. § C 13 (1918) 277.

*Lepeostegeres amplifolius* MERR., Enum. Philip. Fl. Pl. 2 (1923) 101; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 320; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 62.

*Thaumasianthes amplifolia* DANS., Rec. Trav. Bot. Néerl. 30 (1933) 465, ic. 1.

Omnis glabra. Ramuli subrobusti, internodiis juvenilibus teretibus apicem versus paulum applanatis nonnunquam ancipitibus et dilatatis, folia adulta ferentibus 6 ad 10 mm longis, 2.5 ad 5 mm crassis, vetustioribus teretibus nodis incrassatis. Folia opposita; petiolus prope basin supra paulum subtus valde rotundatus, laminam versus magis applanatus, difficile a lamina distinguendus, 6 ad 16 mm longus; lamina late vel anguste ovata, 13 ad 20 cm longa, 6 ad 15 cm lata, sub basi late rotundata breve in petiolum contracta vel in foliis angustioribus basi magis cuneata, apice subobtusa vel subacuta, tenuiter coriacea, utraque facie opaca, inferiore (in herbario) magis rufa quam superiore, penninervis, costa et nervis lateralibus crassioribus utrinque distinctis, venis tenuioribus subtus tantum visibilibus. Inflorescentiae singulae in axillis foliiferis et defoliatis, omnino sessiles; receptaculum 4 mm longum, 1.5 mm crassum; bracteae in paribus 5 decussatis positae, cuneatae, angulis rotundatis, exterioribus magis latae quam longae, fere transverse ovales, c. 9 mm longae, 14 ad 18 mm latae, interiores gradatim angustiores intimae anguste spathulatae, parium primi, tertii et quinti convexae et gibbae non carinatae, secundi et quarti parte apicali carinatae; bracteae florum lateralium triadum acute carinatae, 7 ad 9 mm longae bis 2 ad 2.5 mm latae; bracteae florum mediorum spathulatae c. 8 mm longae sub apice rotundata 1.25 mm latae; bracteolae variabiles, planae, 3 ad 7 mm longae, c. 1 mm latae. Calicis tubus parte inferiore cylindrica 2 mm longa, 0.75 mm lata et parte superiore cupuliformi 1 mm longa, 1.5 mm lata; limbus mebranaceus, irregulariter laceratus, c. 0.5 mm longus. Corolla statu alabastri adulti c. 21 mm longa, supra partem basalem anguste cylindricam ad 5 mm inflata, deinde attenuata subcylindrica sulcis 6, apice obtusissima fere truncata, statu aperta tubo c. 7 mm longo basi vix 1 mm apice 3 mm lato, e basi c. 1.25 mm lata sensim attenuatis, c. 4 mm sub apice reflexis, sub flexura c. 0.3 mm latis, supra flexurum naviculatis crassiusculis obtusis c. 0.5 mm latis. Filamenti pars libera 0.25 ad 0.75 mm longa; anthera linearis acuta c. 2 ad 2.5 mm longa, loculis, 4 continuis. Stylus corolla aequilongus, c. 0.3 mm crassus, sub stigmate ad dimidiam crassitudinem attenuatus; stigma globosum stylo aequicrassum. Fructus ignotus.

SAMAR, Catbalogan, 28 m elevation, *Bur. Sci. 17448 Ramos* (M, type, L, cotype of *Loranthus amplifolius* Merr.), flower red, but petals green and yellow; Loquilocon, 250 m elevation, *Bur. Sci. 43843 McGregor* (M, UC, NY), flower green at base, pink at top. LEYTE, Mount Abucayan, *Bur. Sci. 41765 Edaño* (B, L).

### 2. THAUMASIANTHES OVATIBRACTEA (Merrill) Danser.

*Loranthus ovatibracteus* MERR., Philip. Journ. Sci. § C **13** (1918) 278.

*Lepeostegeres ovatibracteus* MERR., Enum. Philip. Fl. Pl. **2** (1923) 101; DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 321; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 **29** 6 (1933) 63.

*Thaumasianthes ovatibractea* DANS., Rec. Trav. Bot. Néerl. **30** (1933) 466.

"A parasitic, glabrous shrub, the branches and branchlets terete, the former pale- the latter dark-brown, smooth, the internodes 2 to 5 cm long. Leaves opposite, oblong-ovate, coriaceous, shining, 12 to 15 cm long, 5.5 to 7.5 cm wide, narrowed upward to the obtuse apex and below to the acute or somewhat decurrent-acuminate base, the upper surface dark brownish-olivaceous, the lower surface pale-brownish; lateral nerves 6 to 8 on each side of the midrib, slender, very obscure, often evanescent, the secondary nerves and reticulations obsolete; petioles 5 to 8 mm long. Heads axillary, sessile, 12- to 15-flowered, the outer four bracts

ovate, coriaceous, acute, more or less keeled, about 13 mm long, the bracteoles subtending the triads elliptic to oblong-elliptic, keeled, 7 to 11 mm long, 3.5 to 6 mm wide. Flowers 6-merous, red, sessile, each triad subtended by a bracteole. Calyx cylindric, somewhat thickened upward, 3 mm long, the limb produced about 1 mm, somewhat spreading, thin, more or less crenate-lacerate. Corolla in bud about 18 mm long, cylindric, somewhat enlarged in the median portion, the lobes wholly united for the lower 5 mm, the free parts 1.5 mm wide below, narrowed upward, the part above the insertion of the anther linear, reflexed, 3.5 mm long, acute. Anther linear, subsessile, 2.5 mm long."

As the only specimen of this species seen by me is the type specimen in the Philippine National Herbarium, and this is not sufficient to improve Merrill's original description, I cite the latter without alterations, though I doubt that Merrill describes the bracteoles correctly. On one hand the inflorescences of the type specimen were too much damaged to state with certainty that this species really belongs to *Thaumasianthes;* on the other hand, the resemblance to *T. amplifolia* is so great that it seems doubtful that *T. ovatibractea* can be kept separated from that species. The differences from *T. amplifolia* that I could discover on the type specimen of *T. ovatibractea* are the following: The dimensions of twigs and leaves are smaller; the internodes are 1.5 to 5.5 cm long, the largest leaves are 15 cm long, 7 cm broad; moreover, the leaves are somewhat thicker-coriaceous. The four outer involucral bracts are ovate and all of them keeled over the whole length, the outer ones are hardly 10 mm long and 7 mm broad. The flowers are somewhat narrower and slenderer, the reflexed part of the petals and the free part of the filaments about 0.5 mm shorter.

SAMAR, Camaniwan, on Catubig River, 55 m altitude, *Bur. Sci. 24135 Ramos* (M, type of *Loranthus ovatibracteus* Merr.).

### V. Genus MACROSOLEN Blume

*Macrosolen* BLUME, in Schult., Syst. 7 2 (1930) 1731; MIQ., Fl. Ind. Bat., 1 1 (1856) 827; Suppl. Sum. (1860) 138, 346; VAN TIEGH., Bull. Soc. Bot. Fr. **41** (1894) 143, 268; **42** (1895) 438, 442, 449; DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 291, 343, 358, 364; **11** (1931) 271; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 **29** 6 (1933) 91.

*Tristerix* MART., Flora **1** (1830) 108, p. p., non Blume (1830).

*Blumella* p. p. and *Miquelina* VAN TIEGH., Bull. Soc. Bot. Fr. **42** (1895) 438, 441, 443, 449.

Inflorescentia racemosa vel spicata, rarius umbellata vel subcapitata, floribus bractea 1 bracteolisque 2 liberis vel connatis. Flores 6-meres, sympetali; corolla tubo magis minusve dilatato supra carinis 6 cum petalis alternatibus, statu alabastri apicem versus primum in collum attenuata deinde in clavam terminalem incrassata, postea usque ad carinas dehiscens in lacinias 6 recurvatas spathulatas. Antherae basifixea, obtusae, loculis 4 plerumque continuis rarius locellatis. Stylus supra basin articulatus, frustui rostrum breve relinquens.

*Macrosolen* is chiefly spread in the southeastern part of the Asiatic Continent and the northern and western parts of the Malay Archipelago; few species occur in the central portion of this archipelago and one species is found in New Guinea. In the Philippines eleven species may be distinguished, ten of which are endemic.

*Key to the Philippine species of Macrosolen.*

1. Flowers pedicellate, in racemes or umbels ........ 2.
Flowers sessile on the tip of a common peduncle ........ 7.
2. Corolla nearly 65 mm long ........ 6. *M. Acunae.*
Corolla 12 to 20 mm long ........ 3.
3. Corolla lobes outside near the tip with an appendage, the six appendages forming a small crown round the tip of the bud; twigs flattened-quadrangular ........ 3. *M. curtiflorus.*
Corolla lobes without such an appendage; young twigs terete or flattened, but not quadrangular ........ 4.
4. Corolla nearly 18 mm long ........ 5.
Corolla, at most, 15 mm long ........ 6.
5. Flowers in a short raceme, very shortly pedicelled ........ 4. *M. Demesae.*
Flowers in a 4-flowered umbel ........ 5. *M. bellus.*
6. Calyx with cylindrical tube and spreading limb; leaves very small, acute at the base and the apex ........ 2. *M. surigaoensis.*
Calyx with ellipsoidal tube and infundibuliformous limb; leaves larger and usually differently shaped ........ 1. *M. cochinchinensis.*
7. Corolla nearly 65 mm long ........ 11. *M. subsessilis.*
Corolla 12 to 16 mm long ........ 8.
8. Twigs sharply flattened-quadrangular ........ 10. *M. angulatus.*
Twigs terete ........ 9.
9. Inflorescence 3- or 4-flowered; style articulate about 2 mm above the base ........ 7. *M. Mcgregorii.*
Inflorescence 2-flowered; style base shorter ........ 10.
10. Leaves very different above and below, petioled, the lamina narrowed into the petiole ........ 8. *M. geminatus.*
Leaves nearly alike above and below, sessile with rounded base.
9. *M. Worcesteri.*

**1. MACROSOLEN COCHINCHINENSIS (Loureiro) Van Tieghem.**

*Loranthus cochinchinensis* LOUR., Fl. Cochinch. (1790) 195.

*Loranthus sphaerocarpus* BLUME, Verh. Bat. Genootsch. 9 (1823) 189; FER.-VILL., Nov. App. (1880) 184; MERR., Enum. Philip. Fl. Pl. 2 (1923) 112.

*Loranthus globosus* ROXB., Fl. Ind. ed. 1 2 (1824) 206; FER.-VILL., Nov. App. (1880) 184; VIDAL, Revis. Pl. Vasc. Philip. (1886) 230.

*Loranthus ampullaceus* ROXB., Fl. Ind. ed. 1 2 (1824) 209; FER.-VILL., Nov. App. (1880) 184; VIDAL, Pl. Cuming. Philip. (1885) 76, 140; MERR., Philip. Journ. Sci. § C 4 (1909) 145 excl. specim.

*Loranthus patulus* JACK, in Roxb. Fl. Ind. ed. 1 2 (1824) 214.

*Loranthus viridiflorus* WALL., in Rox. Fl. Ind. ed. 1 2 (1824) 219.

*Loranthus subumbellatus* BLUME, Bijdr. 13 (1825) 662.

*Loranthus carinatulus* DC., Mém. Lor. (1830) 26, t. 3; FER.-VILL., Nov. App. (1830) 184; MERR., Enum. Philip. Fl. Pl. 2 (1923) 111.

*Loranthus subglobosus* and *oleoides* DC., Prodr. 4 (1830) 297.

*Loranthus pallens* DC., Prodr. 4 (1830) 297; FER.-VILL., Nov. App. (1880) 184.

*Tristerix viridiflorus* MART., Flora 1 (1830) 109.

*Loranthus oleifolius* SCHULT., Syst. 7 2 (1830) 1650 nom. nud.

*Elytranthe ampullacea* G. DON, Gen. Hist. Dichl. Pl. 3 (1834) 425; MERR., Philip. Journ. Sci. Suppl. 1 (1906) 50; Spec. Blanco. (1918) 132.

*Elytranthe carinatula, viridiflora, subglobosa, pallens, oleoides, globosa, sphaerocarpa, patula, subumbellata* G. DON, Gen. Hist. Dichl. Pl. 3 (1834) 426–427.

*Elytranthe cochinchinensis* G. DON, Gen. Hist. Dichl. Pl. 3 (1834) 426; MERR., Enum. Philip. Fl. Pl. 2 (1923) 100 excl. specim.

*Hillia longiflora* BLANCO, Fl. Fil. ed. 1 (1837) 235.

*Macrosolen sphaerocarpus, pallens, oleoides, patulus* MIQ., Fl. Ind. Bat. 1 1 (1856) 830–831.

*Macrosolen ampullaceus* ETTINGSH., Denkschr. Akad. Wissensch. Wien, Math.-Naturwiss. Cl. 32 (1872) 76.

*Macrosolen cochinchinensis* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 122; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 343; 11 (1931) 279.

*Macrosolen carinatulus, viridiflorus, subumbellatus, globosus* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 442.

*Loranthus sphaerocephalus* WURTH, Versl. Vezelcongr. 1 2 (1911) 92.

*Elytranthe Barnesii* GAMBLE, Kew Bull. (1913) 45.

*Loranthus Elmeri* MERR., Philip. Journ. Sci. § C 9 (1914) 285.

*Loranthus tribracteatus* RIDLEY, Journ. Fed. Mal. St. Mus. 8 4 (1917) 31.

*Elytranthe Elmeri* MERR., Enum. Philip. Fl. Pl. 2 (1923) 101.

*Macrosolen tribacteatus* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 346.

For a more extensive list of literature see Bull. Jard. Bot. Buitenzorg III 11: 279–282.

Glabra vel inflorescentiis floribusque densissime puberulis; subgracilis, ramosissima, stolonibus plantae nutrici affixa. Internodia juvenilia teretia, nodis applanatis et incrassatis, folia adulta ferentia 1 ad 3 mm crassa, vetustiora teretia nodis incrassatis. Folia opposita vel subopposita; petiolus teres, facie superiore laminam versus applanatus, 3 ad 8 mm longus, 1 ad 2.5 mm crassus; lamina coriacea, late elliptica ad lanceolata vel paulum ovata, plerumque 4 ad 12 cm longa, 2 ad 7 cm lata, basi cuneata vel rotundata, apicem subobtusum versus magis vel minus acuminata, supra lucida vel semilucida raro opaca, subtus opaca, penninervis, costa supra plana vel paulum prominente subtus valde prominente, nervis lateralibus in planta viva supra tantum, in herbario etiam subtus distinctis. Inflorescentiae plerumque in axillis foliorum singulae et in nodis vestustioribus numerosiores, racemi floribus decussatis vel superioribus umbellatim congestis; axis teres 0.5 ad 2.5 cm longus, basi bene 1 mm crassus apicem versus tenuior; pedicelli 0 ad 6 mm longi, 0.5 ad 0.7 mm crassi, bractea rotundato-ovata, acuta vel breve acuminata, c. 1 mm longa et lata; bracteolae c. 0.5 mm longae, suborbiculares, liberae vel magis minusve connatae. Calicis tubus breve ellipsoides, c. 2.5 mm longus, 2 mm latus, sub limbo distincto sed brevi ad 0.5 mm longo integro vel 6-lobato contractus. Corolla statu alabastri adulti 8 ad 15 mm longa, dimidia parte inferiore inflata, basi rotundata, sub medio carinis acutis 6, medio subabrupte attenuata in collum 1 ad 1.5 mm crassum, deinde in clavam obtusissimam incrassata, postea laciniis recurvatis linearibus paulum spathulatis crassiusculis cucullatis. Anthera c. 0.5 mm longa. Stylus corollae aequilongus; stigma clavatum. Fructus globosus vel subglobosus, denique 6 ad 7 mm longus, 6 mm crassus, styli basi et calicis limbo coronatus; semen ellipsoides.

The color of the corolla is, after my observations on living Java specimens, yellow or greenish yellow, often, however, more or less tinged with red, and always with a more or less distinct dark violet-brown girdle at the base of the neck of the bud. The fruit is, in the ripe state, first green, then yellow, at length dark brown-violet, but it is usually eaten by birds before it has its final color.

This species, common in the tropical southeastern part of the Asiatic Continent and the western part of the Malay Archipelago, is, in the Philippines, restricted to central and southern Luzon, and Palawan; a few specimens, recorded by me for

Mindanao, are insufficient for certain determination, but it is doubtful that *M. cochinchinensis* occurs also in that island.

Philippines, without exact locality, *Cuming 2343* (Be); "Mandaloyon," *Comisión de la Flora Forestal de Filipinas 545* (L). LUZON, Nueva Ecija Province, 100 m elevation, *F. B. 8459 Curran* (M): Bataan Province, Lamao River, near Lamao, *Whitford 86* (M, Be): Bulacan Province, Angat, *Bur. Sci. 76578 Quisumbing* (M): Rizal Province, Santa Ines, *Bur. Sci. 26206* (M); Antipolo, *F. B. 479 Ahern's collector* (M, B, S); Bosoboso, *Bur. Sci. 979 Ramos* (M, B, Be), *Merrill, Sp. Blancoanae 1033 Ramos* (M, NY, B, L): Cavite Province, Alfonso, 150 m elevation, *Bur. Sci. 22568 Ramos and Deroy* (M, NY, B, S, L): Laguna Province, Aleng Malawin Loop, *F. B. 24917 Mabesa* (M); Los Baños, 100 to 120 m elevation, *F. B. 26899 Mabesa* (M); Mount Maquiling, Los Baños, *Elmer 17508* (M, B, L, U) and *17745* (M, UC, B, L, U): Batangas Province, Tanauan, *Aldaba s. n.* (M). MINDANAO, Bukidnon Province, Mount Dumalucpihan (Mount Bunanan), 1,300 m elevation, *Bur. Sci. 39003 Ramos and Edaño* (M): Lanao Province, Dipolog, 20 m, *F. B. 30246 Roque* (M, UC, NY). PALAWAN, *F. B. 3581 Curran* (M); Taytay, *Merrill 9207* (M, NY, B, L, S); Puerto Princesa, Mount Pulgar, *Elmer 12749* (B, NY, L, U, Be, cotypes of *Loranthus Elmeri* Merr.) and *13138* (M, NY, B, U, L, Be).

This species has a further distribution in the tropical part of southeastern Asia, including the Malay Peninsula, and the western part of the Malay Archipelago from Sumatra and Java to Celebes.

**2. MACROSOLEN SURIGAOENSIS (Elmer) Danser.**

*Loranthus surigaoensis* ELMER, Leafl. Philip. Bot. 6 (1913); MERR., Enum. Philip. Fl. Pl. 2 (1923) 110.

*Macrosolen surigaoensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 345; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 94.

"Stems ascending, branched from near the base, bendable; wood whitish and pith brown, covered with a smooth brown bark. Leaves opposite, copious, ascending, thickly coriaceous, blackish when dry, flat, often appearing somewhat inequilateral entire, sharply or bluntly acuminate, the larger ones 4 cm long by 1.25 cm wide across the middle or just below it, base obtuse or cuneata, glabrous, midrib black and conspicuous beneath; lateral ascending nerves about 3 to 4 on each side and very minute or obscure, reticulations none; petiole 3 to 5 mm long, similar to the midrib in color both in the fresh and in the dry state.

Peduncles ascending, strict, slender, solitary or in axillary pairs, less than 1 cm long, glabrous, normally terminated by 2 divaricate flowers; pedicel 1–3 mm long, articulate at the base, terminated by a broadly 3-toothed cupular rim; calyx cylindric, glabrous, green, solitary and sessile, its rim relatively broad and truncate, bud corolla 1.25 cm long, glabrous, ovately elongated, striately ridged on the exterior, apparently becoming 6-segmented, the distal portion becoming reflexed; stamens 6, opposite the segments and inserted upon the throat, anthers introrse, style smooth, as long as the corolla with stamens, terete and fleshy, slightly thickened toward the greenish stigma."

Of this species I have only seen some fragments of a cotype in the Philippine National Herbarium, Bureau of Science, Manila, insufficient to base a description upon. For this reason I copy nearly entirely Elmer's original description.

*Macrosolen surigaoensis* differs from *M. cochinchinensis* by thin twigs and small leaves, which are, moreover, relatively narrower and dull on both surfaces; the peduncles bear only two flowers on their tip; the bracts and bracteoles are roundish, very obtuse and the bracteoles are connate, but the bract is not connate with the bracteoles; the calyx is cylindric, the limb strikingly long in relation to the tube, and spreading; the corolla is, according to Elmer, only 12.5 mm long, this agreeing only with the smallest flowers in *M. cochinchinensis.*

MINDANAO, Agusan Province, Mount Urdaneta, 1,875 m elevation, *Elmer 14098* (M), cotype.

### 3. MACROSOLEN CURTIFLORUS (Elmer) Danser.

*Loranthus curtiflorus* ELMER, Leafl. Philip. Bot. 6 (1913) 1964; MERR., Enum. Philip. Fl. Pl. 2 (1923) 104.

*Macrosolen curtiflorus* DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 344; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 92.

Glabra. Ramuli subgraciles, internodiis juvenilibus e basi terete vel paulum applanata apicem versus magis applanata denique applanate quadriangulis, folia adulta ferentibus 15 ad 25 mm longis, supra basin 1.25 ad 1.5 mm crassis apice c. 4 mm latis, vetustioribus teretibus nodis incrassatis. Folia opposita vel subopposita; petiolus e basi subtereti laminam versus supra sensim applanatus, difficile a lamina distinguendus c. 5 ad 8 mm longus; lamina elliptica, plerumque 3 ad 5 cm longa, 1.5 ad 3 cm lata, e basi cuneata paulum in petiolum decurrens, apice obtusa subrotundata, tenuiter coriacea, utraque facie opaca, penniner-

vis, costa facie inferiore valde prominente carinata, superiore minus prominente rotundata, nervis ceteris omnibus subtus distinctis, supra minus distinctis. Inflorescentiae singulae in axillis foliorum, racemi paribus 2 florum decussatis nonnunquam in umbellam congestis, nodis valde articulatae; pedunculus 6 ad 10 mm longus, vix 1 mm crassus, cum axi cetero vix 0.5 mm crasso 0 ad 5 mm longo apicem versus paulum incrassato et applanato teres; pedicelli 2 ad 3 mm longi, raro breviores, 0.6 ad 0.75 mm crassi, apice paulo crassiores quam basi; bractea ovata late affixa carinata 1.5 ad 2 mm longa, obtusa vel acuta; bracteolae c. duas tertias longitudinis bracteae attingentes, obtusiores, ad dimidiam longitudinem connatae. Calicis tubus cylindricus, c. 2.5 mm longus, 1 mm latus; limbus infundibuliformis, c. 1 mm longus subinteger. Corolla statu alabastri adulti c. 15 mm longa, in duabus tertiis partibus inferioribus ellipsoiditer inflata ad 4 mm lata, tertia parte superiore circiter cylindrica vel 6-angularis, in dorso cuiusque laciniae prope apicem appendice quadrata vel paulum cuneata, appendicibus 6 in alabastro coronulam integram vel leviter lobatam formantibus; "the segments 6, separating down to the middle and ultimately to the base, linearly oblong." Anthera "nearly 3 mm long, truncately rounded at apex." Stylus articulatus supra basin, rostrum c. 0.75 mm longum in fructu relinquens; stigma "flattened capitate." Cetera ignota.

The most peculiar character of *M. curtiflorus* is the crown around the tip of the flower bud, formed by appendages on the back of the corolla lobes. Such appendages also occur in other Loranthaceæ, among the Philippine species in *Amyema verticillata,* among the African species in the species of *Tapinanthus* which Van Tieghem placed in his genera *Acrostephanus* and *Stephaniscus,* such as *Tapinanthus gabonensis, T. Buchneri, T. dependens, T. ogowensis,* and *T. Poggei.* Another peculiar character of *M. curtiflorus,* by which it is easily distinguished from *M. cochinchinensis,* is the young internodes flattened-quadrangular toward the apex.

MINDANAO, Agusan Province, Mount Urdaneta, Cabadbaran, 1,800 m elevation, *Elmer 14089* (M, cotype).

**4. MACROSOLEN DEMESAE (Merrill) Danser.**

*Loranthus Demesae* MERR., Philip. Journ. Sci. § C 9 (1914) 280; Enum. Philip. Fl. Pl. 2 (1923) 104.

*Macrosolen Demesae* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 344; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 93.

Glabra, subgracilis, ramosissima, stolonibus 1.5 ad 4 mm crassis plantae nutrici affixa. Internodia juniora teretia, nodis paulum applanatis, quae folia adulta ferunt 3 ad 6 cm longa, 1.5 ad 3 mm crassa, vetustiora teretia nodis incrassatis. Folia opposita, subsessilia, rotundato-ovata, 4 ad 9 cm longa, 2.5 ad 6 cm lata, basi rotundata vel levissime cordata, apicem versus breve acuminata, tenuiter coriacea, utraque facie opaca, penninervia, costa facie inferiore valde superiore leviter prominente, nervis lateralibus omnibus utraque facie visibilibus superiore paulo distinctioribus quam inferiore. Inflorescentiae racemi breves axillares, paribus 2 vel 3 florum; axis pauca mm longus, 1 mm crassus; pedicelli c. tam longi quam crassi; bractea brevissime triangulatis acuta; bracteolae in unam reniformem connatae, brevissimae. Calicis tubus ellipsoides, 2 mm longus, vix mm 1 latus, apice non contractus, sensim in limbum infundibuliformen integrum c. 0.3 mm longum ampliatus. Corolla 16 ad 18 mm longa; tubus c. 0.6 totius longitudinis attingens, ellipsoides, apice carinis 6 acutis; laciniae e basi usque ad dimidiam ipsarum longitudinis attenuatae deinde in partem apicalem lanceolatam 0.6 mm latam crassiusculam apice incrassatam obtusam dilatatae. Filamenti pars libera c. 1.5 mm longa; anthera c. 2 mm longa, obtusa. Cetera ignota.

Allied to the following species.

MINDANAO, Zamboanga Province, Talisay, 40 to 50 m elevation, *F. B. 13788 Foxworthy, Demesa, and Villamil* (M, type), flower red.

**5. MACROSOLEN BELLUS Danser sp. nov. Plate 1, figs. 3 and 4.**

Subrobusta, ramosissima, omnis glabra. Internodia teretia, quae folia ferunt 2 ad 6 cm longa, 1.5 ad 3 mm crassa, apicem versus paulum incrassata. Folia opposita vel subopposita; petiolus difficile a lamina distinguendus, parte alata inclusa 4 ad 7 mm longus basi teres, laminam versus supra sensim applanatus, prope laminam ad 3 mm lata, supra plana subtus convexa; lamina oblonga vel paulum ovata, 5 ad 10 cm longa, 2 ad 4 cm lata, basin decurrentem et apicem obtusum versus cuneata, tenuiter coriacea, facie superiore lucida inferiore opaca, costa subtus valde prominente supra leviter convexa, nervis lateralibus crassioribus venisque facie inferiore distinctis superiore minus distinctis vel invisibilibus. Inflorescentiae singulae in axillis superioribus et paucae in axillis inferioribus, etiam gregatim in nodis defoliatis, umbellae pedunculatae paribus florum 2 raro 1; pedunculus 1 ad 6 mm longus, teretes, 0.5 ad 0.75 mm crassus, basi apiceque leviter incrassatus; pedicelli 1 ad 1.5 mm longi, teretes; bracteae ovatae acutae vel obtusae, convexae, c. 1 mm longae; bracteolae minores. Calicis oblongo-ovatus, c. 3 mm longus basi rotundatus, ad tertiam partem longitudinis c. 1 mm latus, deinde sensim attenuatus et denique sensim in limbum 0.5 ad 1 mm longum integrum vel leviter lobatum ampliatus. Corolla statu alabastri adulti c. 19 mm longa, a basi rotundata usque ad duas quintas longitudinis ellipsoiditer ad c. 5 mm ampliatus apice partis inflatae carinis 6 distinctis, deinde in collum 1.5 ad 2 mm latum attenuata, denique in clavam 6-angulam subobtusam incrassata, postea usque ad carinas dehiscens in lacinias 6 recurvatas lanceolatas apice crassiusculas acutas. Filamenti pars libera c. 3 mm longa; anthera c. 2.5 mm longa. Stylus tertia parte superiore paulum crassior, c. 1 mm supra basin articulatus, rostrum prismaticum in fructu relinquens; stigma subglobosum. Cetera ignota.

Among the Philippine species *M. bellus* is closely related only to *M. Demesae,* but the latter species differs from it by more racemose inflorescences, shorter-pedicelled flowers, smaller bracts, different dimensions of the flowers, and different leaves. Among the species of the western Malay Archipelago *M. tenuiflorus,* from Borneo, *M. Lowii,* from the Malay Peninsula, and *M. sumatrana,* from Sumatra, are more closely related.

CATANDUANES, back of Calolbong, summit in forest, 300 m elevation, *Bur. Sci. 30447 Ramos and Chan* (M), type, climbing on tree, flower red, with five blue petals, and yellow inside.

**6. MACROSOLEN ACUNAE (Merrill) Danser.**

*Elytranthe acuñae* MERR., Philip. Journ. Sci. § C 13 (1918) 279; Enum. Philip. Fl. Pl. 2 (1923) 100.

*Macrosolen Acunae* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 343; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 91.

Glabra vel inflorescentiis et alabastris juvenilibus breve denseque papillosis; valde robusta. Internoda juniora teretia, versus nodos foliatos paulum applanata; ramulorum partes inter 2 paria foliorum normalium 6 ad 12 cm longae, 3 ad 7 mm crassae, internodia vetustiora teretia nodis incrassatis. Folia opposita, paribus foliorum normalium plerumque cum paribus abortivorum alternantibus; folia abortiva vix visibilia, ad squamulas minimas reducta; folia normalia magna; petiolus 5 ad 7 mm longus, lateraliter applanatus, supra leviter canaliculatus subtus rotundatus; lamina ovato-oblonga vel ovato-lanceolata, 16 ad 37 cm longa, 5 ad 13 cm lata, basi cuneata ad leviter cordata, apicem acutum versus sensim attenuata vel magis acuminata, nonnunquam in acumen longum protracta, crassiuscule coriacea, utraque facie opaca, penninervis, costa subtus valde supra leviter prominente, nervis lateralibus supra leviter subtus magis prominentibus, venis utrinque subdistinctis. Inflorescentiae racemi breves densi, singulae vel paucae in axillis foliorum adultorum et gregatim in nodis defoliatis, etiam in nodis folia abortiva ferentibus ramulorum vetustiorum; axis 1 ad 1.5 cm longus, supra basin paulum incrassatam c. 2 mm crassus, apicem versus sensim attenuatus, 2 ad 3 mm inferioribus nudus, ceterum paribus 6 ad 8 confertis descussatis florum; pedicelli florum inferiorum c. 2 mm longi, superiorum paulo breviores; bracteae ovatae acutae vel valde acuminatae, dorso rotundatae vel carinatae acutae ad 2 mm acuminatae, ad 4 mm longae, 1.5 ad 1.75 mm latae; bracteolae vix 2 mm longae, non acuminatae, in unam suborbicularem bicuspidatam connatae. Calicis tubus cylindricus, c. 3.5 mm longus, 1 mm latus; limbus cupulatus, 1 mm altus, supra 2.5 mm latus, indistincte dentatus. Corolla statu alabastri adulti c. 65 mm longa, e basi c. 1 mm lata ad tertiam partem longitudinis ad 4 mm ampliata, deinde ad 3 quartas longitudinis subcylindrica, ibi paulum attenuata et carinis 6 c. 1 mm latis, deinde in collum 2.5 mm latam attenuata, denique in clavam terminalem ellipsoidem 6-alatam obtusam 8 mm longam 4 mm latam inflata, postea usque ad carinas dehiscens in lacinias 6 recurvatas, parte reflexa oblonga acuta dorso concava facie anteriore sulca in qua anthera quadrat. Filamenti pars libera c. 6 mm longa; anthera c, 4 mm longa basi nonnihil sagittata, apice obtusa, loculis 4 continuis. Stylus filiformis, corolla aequilonga; stigma globosum, styli apice duplo crassius. Cetera ignota.

The most beautiful among all Philippine Loranthaceæ. Most remarkable are the pairs of rudimentary leaves, with which the pairs of normal leaves usually alternate and which also occur in several other species of *Macrosolen,* such as the Bornean *M. curvinervis* and *M. borneanus.* In general the greatest resemblance is with *M. Beccarii,* from Borneo, which, however, has much shorter corollas (25 to 35 mm long) and differs from *M. Acunae* in several minor characters.

I have not seen the type of the species. However, the specimens on which I based the above description agree so well with the original description, and also the localities where they were collected agree so well with that of the type, that the differences (the type is described with flowers 50 mm, free part of the filament 8 mm, anther 2.3 mm long) seem unimportant.

MINDANAO, Zamboanga Province, Malangas, low altitude, *Bur. Sci. 37413 Ramos and Edaño* (M, Be), flower blood red and yellow; Malangas, Dipacan River, low altitude, *Bur. Sci. 37404 Ramos and Edaño* (M, Be), flower red: Lanao Province, Titunod, along Libas Creek, low altitude, *F. B. 23386 Acuña,* type, not seen by me.

**7. MACROSOLEN MCGREGORII (Merrill) Danser.**

*Loranthus mcgregorii* MERR., Philip. Journ. Sci. § C 4 (1909) 146; Enum. Philip. Fl. Pl. 2 (1923) 106.

*Macrosolen Mcgregorii* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 345; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 93.

Glabra. Internodia juniora teretia nodis incrassatis, novissimis etiam paulum applanatis, quae folia adulta ferunt 1.5 ad 4 cm longa, 1 ad 3.5 mm crassa. Folia opposita sessilia, ovato-oblonga ad ovato-lanceolata, c. 6 ad 8 cm longa, 2 ad 3.5 cm lata, basi rotundata vel cuneata, maxima latitudine plerumque paulum sub medio, apice obtusa vel obtusissima, tenuiter coriacea, faciebus vix distinctis, utrinque costa et nervis lateralibus crassioribus prominentibus distinctis, venis invisibilibus. Inflorescentiae singulae vel paucae in axillis, pedunculo c. 5 longo, 0.5 ad 0.75 mm crasso, apice basique paulum incrassato apice 3 vel 4 floribus sessilibus; bractea bracteolaeque suborbiculares, bractea c. 1.25 mm longa, bracteae paulo breviores in unam late reniformem apicibus 2 rotundatis connatae. Calicis tubus cylindricus, 2.5 ad 3 mm longus, 1 ad 1.25 mm latus; limbus 0.5 ad 0.75 mm longus, infundibuliformis, integer. Corolla crassiuscula, statu alabastri adulti 13 ad 15 mm longa, supra basin rotundatam dimidia parte inferiore ellipsoiditer inflata ad 4 mm lata, deinde in collum breve 6-angulum attenuata, denique in clavam obtusissimam 6-angulam incrassata, postea in lacinias 6 dehiscens, tubum c. 4 mm longum relinquens, laciniis e basi 1.5 mm lata ad dimidiam latitudinem attenuatis et in partem superiorem lanceolatam c. 0.75 mm latam, apice crassiusculam, acutiusculam, dilatatis. Anthera subsessilis, 3 ad 3.5 mm longa, obtusa, loculis 4 continuis. Stylus c. 2 mm supra basin articulatus; stigma globosum, stylo c. duplo crassius. Fructus (probabiliter immaturus) ellipsoides, ad 6 mm longus,

3.5 mm diametro, calicis limbo infundibuliformi et styli basi exserta coronatus.

The nearest allies of *M. Mcgregorii* are *M. geminatus* and *M. Worcesteri,* and the differences from these are so small that I doubt if it can be kept as a separate species. *Macrosolen Mcgregorii* differs from the other two by the 3- or 4-flowered inflorescences, the somewhat smaller flowers, and the longer style rudiment upon the fruit. In leaf shape it chiefly agrees with *M. Worcesteri,* but from this species both *M. Mcgregorii* and *M. geminatus* differ by the subsessile leaves nearly equal on both sides, and the much less-flattened, never double-edged, young internodes.

Merrill describes the flowers of *M. Mcgregorii* as 5-merous; though this may be the case now and then, all the flowers examined by me were 6-merous. The inflorescences Merrill describes as 3- to 6-flowered; all inflorescences seen by me were only 3- or 4-flowered.

BOHOL, Guindulman, *Bur. Sci. 1266 McGregor* (M, type, NY, Be, cotypes), flower yellow.

### 8. MACROSOLEN GEMINATUS (Merrill) Danser.

*Loranthus geminatus* MERR., Philip. Journ. Sci. § C 4 (1909) 146; Enum. Philip. Fl. Pl. 2 (1923) 104.

*Macrosolen geminatus* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 344; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 93.

Glabra, ramosissima. Internodia juniora teretia, apicem versus applanata et dilatata, novissima magis applanata et ancipita, vetustiora denique omnis teretia incrassata, quae folia adulta ferunt medio 2 ad 5 mm crassa. Folia opposita vel subopposita; petiolus difficile a lamina distinguendus, supra basin paulum incrassatam triangulus, laminam versus supra magis plana subtus carinata, parte anguste alata inclusa 3 ad 13 mm longus; lamina ovata vel ovato-oblonga, 4 ad 10 cm longa 1.5 ad 6 cm lata, basi cuneata et margine angusto in petiolum decurrens, apicem obtusum versus plerumque magis minusve acuminata, tenuiter vel crassiuscule coriacea, utraque facie opaca, penninervis costa supra leviter convexa subtus valde prominente carinata, nervis lateralibus et venis utraque facie partim distinctis. Inflorescentiae singulae vel paucae in axillis foliorum, pedunculi apice flores 2 sessiles ferentes; pedunculus 3 ad 5 mm longus, c. 0.75 mm crassus, basi paulum incrassatus; bracteae bracteolae-

que suborbiculares, bractea c. 2 mm longa, bracteolae in unam cuneatam apicibus 2 rotundatis connatae, paulo breviores quam bractea. Calicis tubus teres, c. 4 mm longus, 1.5 mm latus; limbus infundibuliformis, c. 1 mm longus, leviter lobatus. Corolla crassiuscula, statu alabastri adulti 13 ad 16 mm longa, e basi rotundata in dimidia parte inferiore ellipsoides 4 mm lata 6-angula, deinde in collum 6-angulum c. 2 mm latum attenuata et in clavam obtusissimam c. 3 mm latam incrassata, postea dehiscens in lacinias 6, tubo c. 5 mm longo, laciniis recurvatis e basi c. 1.5 mm lata primum in dimidiam latitudinem attenuatis deinde lanceolatis apice crassiusculo subacuto. Anthera subsessilis, c. 3 mm longa, apicem subacutum versus sensim paulum attenuata, loculis 4 continuis. Stylus corolla paulo brevior, dimidia parta superiore stigma versus paulum incrassatus, c. 1 ad 1.25 mm supra basin articulatus; stigma ellipsoides, stylo paulo crassius. Cetera ignota.

SAMAR, Borongan, sea level, *Merrill 11593* (M, B, L, S). MINDANAO, Surigao Province, Catel, low altitude, *Merrill 5444* (M, type, NY, Be, cotypes of *Loranthus geminatus* Merr.).

### 9. MACROSOLEN WORCESTERI (Merrill) Danser.

*Loranthus worcesteri* MERR., Philip. Journ. Sci. § C 9 (1914) 284; Enum. Philip. Fl. Pl. 2 (1923) 111.

*Macrosolen Worcesteri* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 346; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 95.

Glabra, ramosissima. Internodia juniora teretia, apicem versus incrassata et paulum applanata, vetustiora teretia nodis magis incrassata, quae folia ferunt 1.5 ad 4 mm crassa. Folia opposita, sessilia, rotundato-ovata ad lanceolata, 4 ad 12 cm longa, 1.5 ad 8 cm lata, basi cuneata ad leviter cordata, maxima latitudine in vel sub medio, apice obtusa vel rotundata, crassiuscule coriacea, faciebus similibus, leviter lucidis, penninervis, costa convexa, nervis lateralibus et venis leviter prominentibus distinctis. Inflorescentiae singulae vel paucae in axillis foliorum, pedunculi simplices apice flores 2 ferentes; pedunculus 3 ad 5 mm longus, c. 0.6 mm crassus, basi paulum incrassatus; bracteae bracteolaeque suborbiculares, bractea c. 2 mm longa, bracteolae in unam late reniformem biapiculatam connatae, bracteolae paulo breviores. Calicis tubus cylindricus, c. 3 mm longus 1.25 mm latus; limbus infundibuliformis, 0.75 ad 1 mm longus, integer. Corolla crassiuscula, statu alabastri adulti c. 13 mm longa, e basi rotundata dimidia parte inferiore ellipsoides ad 4 mm lata, deinde in collum 6-angulare attenuata et in clavam obtusissimam 6-angulam 3 mm crassam inflata, postea dehiscens in lacinias 6, tubum c. 3 mm longum relinquens, laciniis e basi c. 1.5 mm lata primum ad dimidian latitudinem attenuatis deinde in partem lanceolatam c. 1 mm latam recurvatam dilatatis, apice crassiusculis acutis. Anthera subsessilis, c. 3 mm longa, obtusa, loculis 4 continuis. Stylus c. 0.5 mm supra basin articulatus; stigma globosum, stylo paulo crassius. Cetera ignota.

*Macrosolen Worcesteri* is closely related to *M. geminatus,* and is, like this, perhaps not to be kept separated from *M. Mcgregorii* as a species. The difference with *M. geminatus* is chiefly in the different leaves nearly similar on both sides and sessile, but the flowers are smaller moreover and the young twigs are not double-edged. All these differences are, however, of little importance for specific distinction among Loranthaceæ.

MINDANAO, Bukidnon Province, near Sumilao, *Bur. Sci. 15673 Fénix* (M, type, Be, cotype), flower pink and yellow.

**10. MACROSOLEN ANGULATUS (Elmer) Danser.**

*Loranthus angulatus* ELMER, Leafl. Philip. Bot. 3 (1911) 1074; MERR., Enum. Philip. Fl. Pl. 2 (1923) 102.

*Macrosolen angulàtus* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 343; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 91.

Glabra, ramosissima. Internodia juniora acute quadriangula valde compressa, lateribus concavis angulis fere anguste alatis basi 2.5 ad 4 mm crassa, apicem versus fere duplo latiora ad apices ramulorum longitudine decrescentia 1 ad 2 cm longa, in ramulis vetustioribus ad 7 cm longa minus acute quadriangula vel etiam teretia. Folia opposita; petiolus basi triangulus supra planus subtus carinatus, laminam versus supra latior, 4 ad 7 mm longus; lamina elliptica, basi cuneata et nonnihil in petiolum decurrens, apice obtusa vel rotundata, 4 ad 10 cm longa 2 ad 6.5 cm lata, tenuiter coriacea, utraque facie opaca, penninervis, costa facie superiore valde prominente carinata, superiore convexa, nervis ceteris et venis utrinque distinctis. Inflorescentiae singulae vel paucae in axillis foliorum, pedunculi apice 4 flores sessiles ferentes; pedunculus plerumque 8 ad 9 mm longus 1 ad 1.25 mm crassus basi paulum incrassatus; bracteae bracteolaeque suborbiculares, bractea c. 2 mm longa, bracteolae in unam late reniformem biapiculatam connatae, bracteis paulo breviores. Calicis tubus cylindricus, c. 4 mm longus 1.25 ad 1.5

mm latus; limbus 1 ad 1.25 mm longus infundibuliformis integer vel levissime lobatus. Corolla crassiuscula, statu alabastri adulti c. 12 ad 13 mm longa, e basi rotundata in dimidiam partem inferiorem ellipsoidem inflata, supra carinis 6 acutis, deinde abrupte paulum contracta et in clavam ellipsoidem 6-angulam obtussissimam incrassata, postea in lacinias 6 dehiscens, tubum c. 3.5 mm longum relinquens, laciniis e basi c. 1.25 mm lata primum attenuatis deinde in partem oblongam crassiusculam acutam c. 4 mm longam transientibus, recurvatis sed apice incurvatis. Anthera subsessilis, c. 3 mm longa, obtusissima, loculis 4 continuis. Stylus c. 1 mm supra basim articulatus. Cetera ignota.

*Macrosolen angulatus* is closely related to *M. Mcgregorii, M. geminatus,* and *M. Worcesteri,* but differs more from these three species than these three species among each other. The most striking character is the short, sharply quadrangular, even narrowly winged young internodes. In leaf shape and coarseness of the inflorescences it resembles most *M. geminatus,* but the corolla is much smaller and especially thicker, and the inflorescences are 3- or 4-flowered, as in *M. Mcgregorii.*

MINDANAO, Davao Province, Mount Apo, Todaya, steep ravine along Baruring River, 825 m elevation, *Elmer 10804* (M, NY, B, L, U, Be, cotypes).

### 11. MACROSOLEN SUBSESSILIS (Merrill) Danser.

*Loranthus subsessilis* MERR., Philip. Journ. Sci. § C 7 (1912) 263; Enum. Philip. Fl. Pl. 2 (1923) 110.

*Macrosolen subsessilis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 345; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 94.

Glabra. Ramuli longi gracillimi, internodiis junioribus teretibus nodis paulum applanatis et incrassatis, vetustiora nodis magis incrassatis, folia adulta ferentibus 5 ad 10 cm longis 1 ad 3 mm crassis. Folia opposita; pedunculus e basi tereti paulum incrassata laminam versus supra applanatus, 4 ad 7 mm longus; lamina ovato-oblonga, 8 ad 14 cm longa, 4 ad 6 cm lata, basi rotundata vel cuneata, apicem obtusiusculum versus distincte acuminata, tenuiter coriacea, utraque facie opaca, inferiore dilutius colorata quam superiore, costa subtus valde supra minus prominente, nervis crassioribus facie inferiore visibilibus, nervis lateralibus omnibus utrinque visibilibus. Inflorescentiae singulae supra cicatrices foliorum iam delapsorum, pedunculi breves apice flores 2 sessiles ferentes; pedunculus c. 1.5 mm longus, 2 mm latus; bracteae bracteolaeque cupulam calicis basin circumdantem formantes; bracteae suborbicularis, c. 3 mm longa 4 mm lata; bracteolae in unam late reniformem bracteae aequilongam connatae. Calicis c. 5.5 ad 6 mm longus, 3 mm latus, limbo vix a tubo distinguendo paulum infundibuliformi, c. 1.5 mm longo. Corolla statu alabastri adulti c. 65 mm longa, a basi c. 1.5 mm lata sensim dilatata usque ad duas quintas longitudinis, ibi c. 5 mm lata, quinta parte media subcylindrica apice carinis 6 prominentibus, deinde sensim in collum paulo tantum tenuius attenuata et in clavam 5 mm crassam acute 6-angulam apice paulum acuminatam incrassata, postea deshiscens usque ad carinas in lacinias 6 e basi c. 3 mm lata sensim attenuatas, 15 mm ab apice c. 1.25 mm latas recurvatas, parte apicali anguste lanceolata acuminata c. 2 mm lata crassiuscula, extus concava, intus sulca in qua anthera quadrat. Filamenti pars libera c. 6 mm longa; anthera c. 7 mm longa, 0.4 mm lata, obtusa, loculis 4 continuis. Stylus filiformis, dimidia parte superiore paulo crassior quam inferiore, paulum supra basin articulatus, sub stigmate paulum attenuatus, corollae c. 3 mm longior; stigma globosum, c. 0.75 mm crassum. Cetera ignota.

*Macrosolen subsessilis* is closely related only to *M. dianthus* of the Malay Peninsula, and differs from this species only in rather little-important characters, such as larger bracts and calyces, shorter but wider corollas, and broader and more acute corolla lobes, that produce some resemblance to *M. Acunae* and *M. Beccarii.*

MINDANAO, Zamboanga Province, Sax River, 900 m elevation, *Merrill 8315* (M, type, Be, L, cotypes), flower red; Sax River, near San Ramon, *Williams 2425* (M, NY), flower red.

### VI. Genus LEPIDARIA Van Tieghem

*Lepidaria* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1885) 349, 449; Compt. Rend. Acad. Sci. Paris 153 (1911) 1196, 1198; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 291, 321; 11 (1931) 308; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 63; Rec. Trav. Bot. Néerl. 30 (1933) 471, 1c, 2c.

*Lepidella, Chorilepis, Chorilepidella* VAN TIEGH., Compt. Rend. Acad. Sci. Paris 153 (1911) 1196, 1198.

Inflorescentia capitata, involucro composito e bracteis decussatis, exterioribus sterilibus, interioribus flores singulos sessiles ferentibus. Corolla 6-meres sympetala. Antherae basifixae vel appendice basali levissime dorsifixa, acutae, loculis 4 continuis.

The genus *Lepidaria,* in the Philippines, is restricted to Luzon and is represented there by two species. In Sumatra, Borneo, and the Malay Peninsula there have been found eight species more.

*Key to the Philippine species of Lepidaria.*

1. Involucral bracts thin-coriaceus, rounded at the apex, the innermost ones not connate .......................................................................... 1. *L. Williamsii.*
   Involucral bracts membranaceous, the longer ones acuminate at the apex, the innermost ones connate to a calyptra........................ 2. *L. tetrantha.*
   Compare also the insufficiently known *L. quadriflora* and *L. biflora* Van Tiegh., at the end of the genus.

### 1. LEPIDARIA WILLIAMSII (Merrill) Danser.

*Loranthus williamsii* MERR., Philip. Journ. Sci. § C 4 (1909) 148.
*Lepeostegeres williamsii* MERR., Enum. Philip. Fl. Pl. 2 (1923) 102.
*Lepidaria Williamsii* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 322; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 64.

Glabra, stolonibus numerosis plantae nutrici affixa. Ramuli breves et graciles, ad 40 cm longi, basi ad 7 mm crassi, e basi ramosi, teretes, nodis incrassatis, internodiis folia adulta ferentibus teretibus apicem versus applanatis et dilatatis, 2 ad 3 cm longis parte inferiore 1 ad 2 mm crassis apicem versus ad 2.5 ad 3 mm latis, novissimis parte apicali ancipitibus. Folia opposita; petiolus supra planus subtus rotundatus vel subcostatus, difficillime a lamina distinguendus, 0 ad 5 mm longus; lamina plerumque ovato-lanceolata, nonnunquam lanceolata vel obovato-lanceolata, in foliis majoribus pro longitudine latior; obovato-oblonga, 3 ad 7.5 cm longa, 1 ad 2.75 cm lata, e basi rotundata in petiolum contracta vel in foliis minoribus etiam magis attenuata, apice obtusissima vel rotundata, tenuiter coriacea, utraque facie opaca, penninervis, costa facie inferiore magis prominente quam superiore, nervis lateralibus venisque utrinque distinctis vel indistinctis. Inflorescentiae sessiles, singulae in axillis foliorum vel paucae in nodis defoliatis; receptaculum tempre florendi subcylindricum c. 2.5 mm longum 2 mm latum, postea apice ad 3 mm dilatatum, paribus bractearum 6 ad 7 plerumque confertis rarius internodio singulo 1 mm longo inter paria 2 exteriora et 4 ad 5 interiora; bracteae invulucrum primum globosum, postea oblongius et laxius formans, parium 2 exteriorum breves et crassiusculae vix foliaceae, interiorum abrupte distinctae, ex orbiculari vel paulum transverse elliptico

gradatim longiores et oblongiores, ad 13 ad 16 mm longae, omnes apice rotundatae, exteriores dorso convexiores iam ante tempus florendi deciduae, interiores planiores, post anthesin deciduae. Flores plerumque 4 (3 ad 5), sessiles in cupula subplana margine brevi erecto lacerato vel raro in apices 2 laterales prolongato, 1 ad 1.5 mm diametro. Calicis pressione angulosus, breve campanulatus, c. 1.75 mm longus, basi 1.5 mm apice 2 mm latus, limbo c. 0.25 mm longo irregulariter dentato. Corolla plerumque 6-meres raro 5-meres, regularis sympetala, statu alabastri adulti 22 ad 25 mm longa, basi rotundata, 3 mm supra basin ad 4 mm lata, deinde usque ad 7 mm ab apice sensim ad 1.75 mm attenuata, deinde abrupte paulum incrassata et versus apicem obtusissimum paululum tantum attenuata, postea dehiscens in lacinias 6 raro 5, tubum 4 mm longum late companulatum relinquens; laciniae e basi 1 ad 1.25 mm lata sensim attenuatae usque ad flexuram c. 7 mm ab apice ubi c. 0.6 mm latae, supra flexuram anguste lanceolatae, c. 0.75 mm latae apice obtusiusculae. Filamenti pars libera 0.5 ad 1 mm longa, anthera apicem acutissimum versus sensim attenuata, 4.5 mm longa, loculis 4 continuis. Stylus tota longitudine aequicrassus, parte inferiore levis, superiore sulcis tenuissimis 12, basi articulatus. Fructus ellipsoides, maturus probabiliter 10 mm longus subaequicrassus, calicis limbo brevi coronatus; endospermium rotundato-ellipsoides, c. 6 mm longum, 4 mm crassum.

*Lepidaria Williamsii* is very different from the second Philippine *Lepidaria;* from the species of the western part of the Malay Archipelago it differs by the absence of normal bracteoles at the base of the flowers, the flowers being placed on flat cups, the margin of which is probably formed by the connate bracts.

Philippines, no exact locality, *Cuming 1974* (M). LUZON, Benguet Subprovince, Baguio, *Williams 973* (M, type of *Loranthus Williamsii* Merr., NY, cotype); Naguilian Road, 1,300 m altitude, *Merrill 1784* (M, NY, B, L, S, Be), height of plant c. 2 m, flowers deep purple-red.

**2. LEPIDARIA TETRANTHA (Merrill) Danser.**

*Loranthus tetranthus* MERR., Philip. Journ. Sci. § C 7 (1912) 79.

*Lepeostegeres tetranthus* MERR., Enum. Philip. Fl. Pl. 2 (1923) 101; Enum. Philip. Fl. Pl. 2 (1923) 101.

*Lepidaria tetrantha* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 322; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 64.

Glabra, subgracilis. Internodia novissima apicem versus paulum applanata et dilatata, vetustiora teretia nodis nonnihil incrassata, quae folia adulta ferunt 12 ad 40 mm longa, c. 2 mm crassa. Folia opposita; petiolus supra planus subtus rotundatus, difficile a lamina ditinguendus, 3 ad 5 longus, c. 1 mm latus; lamina plerumque ovato-lanceolata, nonnunquam ovato-oblonga vel magis lanceolata, 4 ad 7 cm longa, 13 ad 22 mm lata, basi sensim in petiolum attenuata, apice obtusa vel obtusissima, utraque facie opaca, crassiuscule coriacea, penninervis, costa tantum visibili supra distincta plana subtus prominente. Inflorescentiae singulae in axillis foliorum vel paucae in nodis defoliatis, omnino sessiles; receptaculum brevisimum, vix a superficie ramuli elevatum; bracteae valde confertae, submembranaceae praecipue versus basin, in paribus c. 10 dispositae, exteriores brevissimae, interiores gradatim oblongiores et longiores, magis acuminatae, paria tria interiora cuspide semicylindrica lamina subaequilonga et paulum recurva, longissimae cuspide inclusa 10 ad 13 mm longae, 3.5 ad 4 mm latae, cuspide exclusa oblongo-ovatae, leviter convexae, 2 intimae connatae in calyptram oviformem, supra basin subirregulariter descissam, praecipue prope basin membranaceam, rostro cylindrico obtuso 2 ad 3 mm longo. Flores 4, in paribus 2 decussatis dispositi, sine ullis bracteolis, omnino sessiles. Calicis campanulatus, c. 3 mm longus, 2 mm latus, limbo erecto c. 0.5 mm longo irregulariter dentato. Corolla regularis sympetala 6-meres, statu alabastri adulti c. 22 mm longa, basi rotundata 3 mm supra basin 3 mm lata, deinde sensim attenuata, dimidia longitudine c. 1.5 mm lata, parte superiore subprismatica 6-angula, in paucis mm superioribus apicem obtusiusculum versus paulum coniformis, postea dehiscens in lacinias 6; tubus late companulatus 3 ad 4 mm longus, laciniae e basi 1.5 mm lata usque ad dimidiam longitudinem in dimidiam latitudinem attenuatae, deinde usque ad apicem fere aequilatae, in 3 mm superioribus paulum tantum attenuatae, apice obtusiusculae, parte superiore, ut videtur, non refractae. Filamenti pars libera c. 1.5 mm longa; anthera apicem acutum versus sensim attenuata, c. 3 mm longa, loculis 4 continuis. Stylus filiformis, in 5 mm superioribus paulo crassior et sub stigmate paulum attenuatus; stigma ellipsoides obtusissimum, styli parte crassiore aequicrassum. Cetera ignota.

*Lepidaria tetrantha* is still more different from the species of *Lepidaria* of the western part of the Malay Archipelago than

*L. Williamsii,* by its membranaceous involucral bracts of which the innermost pair is connate to a calyptra thrown off before the total development of the flowers. Merrill describes the flowers as 4-merous; I found them only normally 6-merous.

LUZON, Mountain Province, Bontoc, Malawey, 1,670 m altitude, *Vanoverbergh 1294* (M, type), height of plant 0.5 m, petals rose and greenish.

The specimen in the Philippine National Herbarium is the only one seen by me. All specimens distributed under the same number and name belong, as far as I saw them, to *Lepeostegeres congestiflorus.*

The following names are of doubtful status:

*Lepidaria quadriflora* and *Lepidaria biflora* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 441; MERR., Enum. Philip. Fl. Pl. 2 (1923) 111; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 321, 322; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 63–64.

*Chorilepis quadriflora* and *Chorilepidalla biflora* VAN TIEGH., Compt. Rend. Ac. Sc. Paris 153 (1911) 1196, 1198.

Van Tieghem describes these two species as follows:

> Ce meme genre [*Lepidaria*] comprend encore deux espèces récoltées à Manille par Cuming. Dans la première (No. 1171), qui a les feuilles sessiles, l'axe de l'épi porte d'abord à la base deux paires de petites écailles, puis se prolonge en un entrenoeud gros et court qui porte autour de son sommet quatre paires de larges écailles, dont les deux derniéres seules sont fertiles; ici encore, l'ensemble des écailles supérieures forme un involucre author d'un capitule quadriflore: ce sera le *L. quadriflora.* Dans la seconde (No. 1174) qui a les feuilles pétiolées et dont l'épi porte aussi deux sortes d'écailles séparées par un gros entre-noeud, les deux dernières écailles de la partie superieure sont seules fertiles et le capitule involucré est par conséquent biflore: ce sera le *L. biflora.*

I did not see *Cuming 1171* and *1174* but on the sheet of *Cuming 1974* in the Philippine National Herbarium, Manila, Merrill has written, "This is a cotype of *Lepidaria biflora* Van Tiegh., in Bull. Soc. Bot. France 42 (1895) 441." I think it quite possible that Merrill is right with this remark, and that the Cuming numbers given by Van Tieghem are erroneous. In Vidal y Soler, Phan. Cuming. Philip., after the number *Cuming 1171,* we find the names *Mallotus* and *Connarus,* and after the number *1174, Bischofia,* but after both the numbers *1971* and *1974* we read: "*Loranthus* (*Lepiostegeres*) sp." So it is probable that *Lepidaria biflora* is really a synonym of *Lepidaria Williamsii;*

yet I cannot accept this name instead of the name used now, as the former is wellnigh a nomen nudum. However, I have not seen *Cuming 1971*, but in case *Lepidaria quadriflora* proves to be an older synonym of either *L. Williamsii* or *L. tetrantha,* I would certainly accept Van Tieghem's name instead of Merrill's, as it cannot be regarded as a nomen nudum and does express a correct character of either species.

## VII. Genus AMYEMA Van Tieghem

*Pilostigma* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 483, 488, 510, 540, 550; 42 (1895) 84, 87.

*Amyema* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 499, 506, 510, 547, 550; 42 (1895) 84, 87; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 291, 293, 362–366; 11 (1931) 236, 238, 318; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 25.

*Neophylum* and *Stemmatophyllum* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 499, 505, 508, 510, 545, 548, 550.

*Benthamina* and *Candollina* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 85, 87, 244, 246, 269, 271.

*Rhizanthemum* VAN TIEGH., in Morot, Journ. de Bot. 15 (1901) 364.

*Cleistoloranthus* MERR., Philip. Journ. Sci. § 4 (1909) 130, 150; KRAUSE, in Engl. and Pr., Nat. Pfl. fam. Nachtr. 4 zu 2–4 (1915) 73.

*Xylochlamys* DOMIN, Bibl. Bot. 22 (1921) 610.

Inflorescentia umbella triadum, saepe vario modo diminuta, statu completo umbella pedunculata multiradiata triadum, floribus pedicellatis vel sessilibus, statu diminuto aut triadibus ad dyades vel flores singulos diminutis, aut triadibus vel dyadibus sessilibus, aut radiis paucis, aut umbella sessilis, casu extremo ad florem singulum reducta. Flores 4 ad 6 meres, choripetali vel rarious sympetali. Antherae basifixae, loculis continuis vel raro locellatis.

The genus *Amyema* is spread all over the Philippines; outside the Philippines it is only spread in a southern direction, and much more to the southeast, where it reaches Australia and New Caledonia, than to the southwest. It is represented in Borneo and Java each by three species, in the Malay Peninsula by only one species, whereas it is entirely wanting in Sumatra. Moreover, two species occur in tropical Africa.

I have reduced the number of Philippine species to seventeen, and to these have added two species new to science. However, several of the nineteen species distinguished by me are of doubtful status. The differences between *A. luzonensis* and *A. benguetensis* are constant, but not great, and as the latter species has only been found as a parasite on *Pinus,* it seems possible that *A. benguetensis* may only be a race of *A. luzonensis* parasitic on conifers, in the same way as *Viscum laxum* has proved to be such a race of *Viscum album. Amyema mosea* differs from *A. acuta* in the same way, but in this case nothing is known about the host of *A. mosea.* The specific distinction of *A. basilanensis* and *A. celebica* is very doubtful. Also *A. fasciculata* and *A. aquilonia* are very closely related. Though the differences are rather large, further material is necessary to make out with certainty whether or not these two are distinct species. *Amyema polillensis* is closely related to *A. umbellata* from the Moluccas (Island of Borneo), and it is perhaps only a form of this species. *Amyema nodosa, A. Hutchinsonii, A. Wenzelii,* and the Bornean *A. Beccarii* constitute a group of closely related species, and though typical forms are very different, the species are not always easily distinguished, and it may be possible that they are only geographic variations of one polymorphous species. These examples are sufficient to show that our knowledge of the Philippine species is far from complete.

*Key to the Philippine species of Amyema.*

1. Flowers in umbels of triads........ 2.
  Flowers in simple, peduncled umbels........ 14.
  Flowers seemingly solitary, in reality in sessile few-flowered umbels. 16.
2. Umbels 8- to many-rayed; corolla sympetalous........ 3.
  Umbels 4- or (rarely) more-rayed; corolla choripetalous........ 7.
3. All flowers of the triads sessile........ 5. *A. incarnatiflora.*
  Lateral flowers of the triads pedicelled, middle flowers pedicelled or sessile........ 4.
4. Umbels with 15 to 50 rays........ 5.
  Umbels with nearly 8 rays........ 6.
5. Peduncle 25 to 50 mm long; flowers 5- or 6-merous. 1. *A. Haenkeana.*
  Peduncle nearly 10 mm long; flowers 4-merous........ 2. *A. Curranii.*
6. Peduncle long; leaves scattered or opposite; middle flowers of the triads sessile........ 3. *A. urdanetensis.*
  Peduncle 4 to 7 mm long; leaves verticillate; middle flowers of the triads pedicellate........ 4. *A. halconensis.*
7. Leaves petioled........ 8.
  Leaves sessile........ 13.
8. Leaves exactly in whorls of four........ 9.
  Leaves scattered or here and there crowded to whorls of four or less. 12.
9. Petals with a dorsal appendage near the tip, the appendages forming together a small crown around the tip of the corolla bud; corolla

17 to 25 mm long; flowers and inflorescences glabrous; middle flowers of the triads sessile or nearly sessile........ 11. *A. verticillata.*

No such appendages at the petals; middle flowers of the triads nearly always distinctly pedicelled, rarely nearly sessile.................................. 10.

10. Inflorescence and flowers entirely glabrous; corolla about 20 mm long. 10. *A. mosea.*

Inflorescence and flowers, especially the calyx, very densely and shortly puberulous ........................................................................................ 11.

11. Corolla 17 to 25 mm long........................................................ 8. *A. acuta.*

Corolla about 28 mm long................................................... 9. *A. medinillicola.*

12. Calyx tube nearly 3 mm long, 1.5 mm wide, calyx limb about 1.25 mm long; corolla 27 to 32, style 28 to 35 mm long............ 12. *A. celebica.*

Calyx tube 1.5 to 2 mm long, 1 mm wide, calyx limb about 0.6 mm long; corolla nearly 17 mm, style nearly 18 mm long. 13. *A. basilanensis.*

13. Inflorescence and flower hairy; corolla and style 25 to 38 mm long. 6. *A. luzonensis.*

Inflorescence and flower glabrous; corolla and style 13 to 20 mm long. 7. *A. benguetensis.*

14. Inflorescence and flower hairy, especially the calyx; corolla 18 to 22 (rarely) 28 mm long; flowers also along the internodes. 15. *A. fasciculata.*

Inflorescence and flower glabrous........................................................... 15.

15. Corolla 14 to 15 mm long; umbel 4-flowered; flowers also along the internodes ....................................................................... 16. *A. aquilonia.*

Corolla 21 to 23 mm long; umbel 4- or more-flowered; inflorescences only at the nodes........................................................... 14. *A. polillensis.*

16. Flowers on the runners and on the older nodes; leaves large and coarse, 11 to 27 cm long, 5 to 15 cm broad, broadest at or below the middle; corolla 12 to 14 mm, style 14 to 16 mm long............ 19. *A. Wenzelii.*

Flowers on the younger and older nodes of the leaf-bearing twigs; leaves medium-sized or smaller, broadest usually above the middle ........................................................................................................ 17.

17. Corolla and style 18 to 22 mm long; leaves mostly opposite, rarely scattered or whorled ........................................... 18. *A. Hutchinsonii.*

Corolla and style 8 to 14 mm long; leaves in whorls of four. 17. *A. nodosa.*

### 1. AMYEMA HAENKEANA (Schulten) Danser.

*Loranthus Haenkeanus* SCHULT., Syst. 7 1 (1829) 113; DC., Prodr. 4 (1830) 304; BLUME, in Schult., Syst. 7 2 (1830) 1612, 1730; Fl. Javae Lor. (1830) 14; DIETR., Syn. 2 (1840) 1077; FER.-VILL., Nov. App. (1880) 184; VIDAL, Pl. Cuming. Philip. (1885) 140; Rev. Pl. Vasc. Filip. (1886) 231; ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 129; MERR., Philip. Journ. Sci. § C 4 (1909) 144 excl. specim.; Fl. Manila (1912) 184; Enum. Philip. Fl. Pl. 2 (1923) 104.

*Loranthus malifolius* SCHULT., Syst. 7 1 (1829) 113; DC., Prodr. 4 (1830) 304; BLUME, in Schult., Syst. 7 2 (1830) 1612, 1730; Fl. Javae Lor. (1830) 14; DIETR., Syn. 2 (1840) 1077; FER.-

VILL., Nov. App. (1880) 184; VIDAL, Pl. Cuming. Philip. (1885) 76, 140; Rev. Pl. Vasc. Filip. (1886) 232; ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 129.

*Dendrophthoe Haenkeana* MART., Flora 1 (1830) 110; in Schult., Syst. 7 2 (1830) 1614; MIQ., Fl. Ind. Bat. 1 1 (1856) 822.

*Scurrula Haenkeana* and *malifolia* G. DON, Gen. Hist. Dichl. Pl. 3 (1834) 423.

*Dendrophthoe malifolia* MIQ., Fl. Ind. Bat. 1 1 (1856) 822.

*Candollina Haenkeana, malifolia, Barthei* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 269.

*Loranthus Barthei* ENGL. and PR., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 129.

*Loranthus halconensis* MERR., Philip. Journ. Sci. § C 4 (1909) 143 p. p.; MERR., and MERRITT, Philip. Journ. Sci. § C 5 (1910) 345; MERR., Enum. Philip. Fl. Pl. 2 (1923) 105 p. p. non Merr. Philip. Journ. Sci. § C 2 (1907) 271.

*Loranthus eucalyptiphyllus* MERR., Philip. Journ. Sci. § C 9 (1915) 444; Enum. Philip. Fl. Pl. 2 (1923) 104.

*Amyema eucalytophylla* and *Haenkeana* DANS,, Bull. Jard. Bot. Buitenzorg III 10 (1929) 295; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 27, 29.

Robusta vel subrobusta, stolonibus numerosis plantae nutrici affixa; glabra inflorescentia floribusque densissime brevissimeque pilosis exceptis. Ramuli teretes vel paulum obtus anguli nodis magis minusve incrassatis, internodiis folia adulta ferentibus plerumque 1 ad 8 cm longis, 2 ad 7 mm crassis, vestustiores crassiores nodis minus incrassatis, saepe torulosi. Folia sparsa vel rarius magis minusve in paria vel in verticillos congesta, in incrassationibus ramulorum inserta; petiolus teres, supra laminam versus paulum applanatus basi vix incrassatus, 10 ad 25 mm longus, 1 ad 3 mm crassus; lamina plerumque ovata ad lanceolata, rarious anguste lanceolata, 5 ad 22 raro ad 30 cm longa 1 ad 7 raro 12 cm lata, basi cuneata vel rotundata raro subcordata, saepe in petiolum contracta, maxima latitudine sub medio saepe propius basin, apicem subobtusum vel obtusum vel rotundatum versus sensim attenuata vel subacuminata, crassa, fragilis, utrinque opaca, rarius facie superiore sublucida, penninervis, costa supra subplana subtus valde prominente, nervis lateralibus venisque crassioribus indistinctis vel invisibilibus. Inflorescentiae raro in axillis foliorum singulae, etiam in nodo terminali, plerumque singulae vel gregatim in nodis ramulorum vetustiorum, nonnunquam etiam in stolonibus, umbellae pedunculatae triadum floribus mediis plerumque sessilibus lateralibus pedicellatis; pedunculus teres, 25 ad 50 mm longus, 1.25 ad 2.5

mm crassus, basi paulum incrassatus, apice in clavam ellipsoidem 3.5 ad 6 mm longam, 2.5 ad 3 mm crassam cicatricibus radiorum vestitam incrassatus; radii in verticillis alternatibus, numero c. 36 ad 64 (6 ad 8 x 6 ad 8), teretes, 3 ad 10 mm longi, 0.5 ad 1.25 mm crassi, apice basique incrassati; pedicelli florum lateralium 1 ad 2 mm longi rarius breviores, c. 0.3 mm crassi, pedicellus floris medii nullus vel raro ad 1 mm longo; bracteae bracteolaeque triangulares obtusae 1 ad 1.5 mm longae. Calicis campanulatus vel subinfundibuliformis, basi semper rotundatus, tubo 2.5 ad 4 mm longo apice 1.5 ad 2.5 mm lata, limbo integro erecto raro subinfundibuliformi, 0.75 ad 1 mm longo. Corolla sympetala, statu alabastri adulti 30 ad 38 mm longa, partibus 0.75 ad 0.8 inferioribus cylindrica 2 mm lata vel supra basin ad 3 mm dilatata, 4 mm superioribus in clavam ellipsoidem obtusam 3 mm crassam incrassata, postea dehiscens in lacinias 5 rarius 6, tubo 2 ad 30 mm longo, si longiore uno latere fisso stylo transitum dante, laciniis linearibus ad 6 ad 8 mm ab apice reflexis supra flexuram lanceolatis vel subspathulatis acutis vel acutiusculis. Filamenti pars libera 3 ad 5 mm longa, anthera 1 ad 4 mm longa, basi nonnihil contracta subarticulata, apice rotundata, loculis 4 continuis. Stylus corolla 1 ad 2 mm longior, tota fere longitudine aequicrassus, in 6 ad 8 mm superioribus sensim ad dimidiam crasitudinem attenuatus; stigma parvum obtusum. Frustus ellipsoides, ad 10 mm longus, 6 mm crassus, calicis limbo permanente erecto 1 ad 1.5 mm longo coronatus.

*Amyema Haenkeana* is somewhat polymorphic, but less than one would expect who is acquainted with the variability of loranthaceous species. The area of distribution is restricted to Luzon, Mindoro, and Sibuyan, but in that area the species appears to be common. It occurs there from sea level up to 450 m altitude.

The color of the flowers, indicated on the herbarium labels, is mostly red, in different hues, rarely yellow.

Philippine Islands, without exact locality, *Haenke s. n.* (UC), fragments of the types of *Loranthus Haenkeanus* and *malifolius* from the herbarium of the Botanic Garden, Deutsche Universität Prag; *Cuming s. n.* (L), *1957* (M), *1947* (M, L, NY, Be, the latter type of *Candollina Haenkeana* Van Tiegh.). LUZON, Ilocos Norte Province, Burgos, 15 to 19 m elevation, *Bur. Sci. 27285, 27287 Ramos* (M); Bangui, *Bur. Sci. 43586 McGregor* (M, UC, B); Piddig, *Bur. Sci. 43625 McGregor* (M, UC): Ilocos

Sur Province, Pidigan, 200 m elevation, *F. B. 5657 Klemme* (M); San Domingo, sea level, *Bernhardt* s. n. (UC); Barrio Lungog, *Clemens 17856* (UC): Abra Province, Peñarubia, *Wester 18862* (M): Mountain Province, Benguet, Dilopirip to Mount Palguingon, *F. B. 15892 Bacani* (M); Mount Pulog, *F. B. 61230 Curran, Merritt, and Zschokke* (M); Bontoc, Bauco, *Vanoverbergh 1505* (M), type of *Loranthus eucalyptiphyllus* Merr.; Lepanto, Sinidab (?), 450 m elevation, *Bona 403* (M): La Union Province, San Fernando, 50 m elevation, *Manangan 13* (M); *Loher 6731* (Be); Castilla, *Loher 6739* (M, Be); Bacnotang, 4 m elevation, *Lete 456* (M); Bauang, *Elmer 5537* (N, NY, Be): Pangasinan Province, Umingan, *F. B. 17698 Otanes* (M): Tarlac Province, *Hall s. n.* (M); San Miguel, *Bur. Sci. 22421 Celestino* (M, L): Nueva Ecija Province, Fiela, Papaya, Peñaranda, *Gates 5311* (M); Cabanatuan, *Bur. Sci. 5271 McGregor* (M): Pampanga Province, Camp Stotsenburg, *Clemens s. n.* (M); Mount Abu, 125 m elevation, Bucudpong-Florida, *Bur. Sci. 1929 Foxworthy* (M): Bataan Province, Lamao Forest Reserve, *Bur. Sci. 1618 Foxworthy* (M); 30 m elevation, *Bur. Sci. 1894 Foxworthy* (M); Lamao River, *F. B. 90 Barnes* (NY): Bulacan Province, Norzagaray, *Yoder 251* (M); Angat, 100 m elevation, *Bur. Sci. 21701 Ramos* (M): Rizal Province, *Ramos 1036* (M, U, Br); *Loher 15059* (K); Pantay, *Bur. Sci. 19199 Reillo* (M); Antipolo, *Bur. Sci. 29524* (M, Be): Manila, *Lyon s. n.* (M). MINDORO, without exact locality, *Bur. Sci. 10870 Celestino* (M); Puerto Galera (Baloteros Maliit), on beach, *Bur. Sci. 15178 Kienholz* (M, UC). SIBUYAN, Capiz Province, Mount Giting-giting, Magallanes, *Elmer 12138* (NY, B, L).

**2. AMYEMA CURRANII (Merrill) Danser.**

*Loranthus curranii* MERR., Philip. Journ. Sci. § C 4 (1909) 144; MERR. and MERRITT, Philip. Journ. Sci. § C 5 (1910) 345; MERR., Enum. Philip. Fl. Pl. 2 (1923) 104.

*Amyema Curranii* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 294; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 27.

Glabra, inflorescentiis et floribus breviter velutinis exceptis, robusta. Ramuli teretes, internodiis folia adulta ferentibus nodis incrassatis, usque ad 6 cm longis, 3 ad 6 mm crassis. Folia sparsa vel fere ternata; petiolus supra basin paulum incrassatam teres, laminam versus supra sensim applanatus, 5 ad 18 mm

longus, 1.25 ad 2.5 mm crassus; lamina ovato-oblonga ad ovato-lanceolata, vel oblongo-lanceolata, 5 ad 18 cm longa, 1.5 ad 5 cm lata, basi rotundata et saepe paulum in petiolum contracta, maxima latitudine magis vel minus sub medio, versus apicem acutiusculum vel obtusum acuta vel subacuminata, crassiuscule coriacea, facie superiore semilucida inferiore opaca, penninervis, costa supra leviter subtus valde prominente, nervis lateralibus venisque supra distinctis ad invisibilibus, subtus indistinctis vel invisibilibus. Inflorescentiae in nodis defoliatis insertae, umbellae pedunculatae triadum floribus mediis sessilibus lateralibus pedicellatis; pedunculus teres, apice in clavam ellipsoidem vel globosam 2.5 ad 2.75 mm longam, 2 ad 2.25 mm crassam cicatricibus radiorum vestitam incrassatus, clava terminali excepta 4 ad 10 mm longus, 1 ad 1.5 mm crassus; radii in verticillis alternantibus dispositi, 18 ad 48 (3 ad 6 x 6 ad 2), 3 ad 4 mm longi; pedicelli florum lateralium c. 0.5 ad 1.5 mm longi; bracteae bracteolaeque 1 ad 2 mm longae. Calicis infundibuliformis, tubo c. 2.5 mm longo basi c. 0.5 mm apice c. 1.5 mm lato, limbo c. 1 mm longo, tubo paulo latiore, infundibuliformis, dentibus breviter triangularibus. Corolla 30 ad 35 mm longa, statu alabastri adulti e basi, c. 1.5 mm lata usque ad 5 mm ab apice subcylindrica, 5 mm superioribus in clavam 2 mm crassam obtusissimam incrassata, postea fissa in 4 lacinias parte reflexa 5 ad 7 mm longa, lanceolata vel spathulata, tubo longo unilateraliter fisso stylum transitum dante. Filamenti pars libera 2.5 ad 4 mm longa; anthera 2 ad 3 mm longa, obtusa, loculis 4 continuis. Stylus filiformis, corolla c. 3 mm longior, tota longitudine aequicrassus; stigma vix crassius, obtusum. Cetera ignota.

*Amyema Curranii* is closely related to *A. Haenkeana*, but shows some remarkable differences from that species; namely, 4-merous slenderer flowers and shorter-peduncled inflorescences. Moreover, data indicate that *A. Curranii* is only found at altitudes of from 1,200 m to 2,250 m. The corolla is indicated as red on the herbarium labels.

LUZON, Mountain Province, Benguet, Mount Santo Tomas 2,250 m elevation, *F. B. 5035 Curran* (M), on *Podocarpus*, type of *Loranthus curranii* Merr.: Ifugao Subprovince, Mount Polis, *Bur. Sci. 19771 McGregor* (M), *Sandkuhl 311* (M): Bontoc Subprovince, Malamey (Pinggat), 1,650 m, *Vanoverbergh 1193* (M, Be): Pangasinan Province, 1,200 m elevation, *F. B. 18032 Merritt* (M, B).

**3. AMYEMA URDANETENSIS (Elmer) Danser.**

*Loranthus urdanetensis* Elmer, Leafl. Philip. Bot. 6 (1913) 1963; Merr., Enum. Philip. Fl. Pl. 2 (1923) 110.

*Loranthus leytensis* Merr., Philip. Journ. Sci. § C 9 (1914) 278; Enum. Fl. Pl. 2 (1923) 106.

*Amyema leytensis* and *urdanetensis* Dans., Bull. Jard. Bot. Buitenzorg III 10 (1929) 296, 299; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 30, 34.

Glabra, inflorescentiis bracteisque calicibusque tenuiter sed dense tomentosis exceptis. Ramuli juniores teretes, internodiis ad foliorum insertiones incrassatis et paulum applanatis, folia adulta ferentibus 1 ad 6 cm longis 1.25 ad 4 mm crassis. Folia sparsa vel subopposita; petiolus basi teres paulum incrassatus, laminam versus supra sensim applanatus vel etiam excavatus, 5 ad 12 mm longus, 0.75 ad 1.5 mm crassus; lamina ovato-oblonga ad lanceolata, 4 ad 8 cm longa, 1 ad 3 cm lata, basi acuta vel subrotundata, apicem obtusiusculum versus acuta vel subacuminata, crassiuscule vel crasse coriacea, costa facie inferiore valde prominente, superiore plana distincta, nervis lateralibus crassioribus supra indistinctis subtus invisibilibus. Inflorescentiae umbellae triadum pedunculatae, floribus mediis sessilibus lateralibus breviter pedicellatis, singula in axillis vel in nodis defoliatis; pedunculus 20 ad 30 mm longus, teres, c. 0.75 mm crassus, apice in capitulum c. 1.5 mm longum, 1.75 mm latum incrassatus; radii c. 8, 2 ad 5 mm longi, 0.3 ad 0.5 mm crassi; pedicelli florum lateralium c. 0.5 mm longi et crassi; bracteae ovatae, acutae, c. 1.5 mm longae, bracteae paulo magis convexae et obtusae, ceterum similes. Calicis campanulato-infundibuliformis, 2 ad 2.5 mm longus, apice 1.25 mm latus, limbo brevi 0.25 ad 0.5 mm longo indistincte dentato. Corolla 30 ad 35 mm longa, statu alabastri adulti e basi c. 1.5 mm lata in duabus tertiis partibus inferioribus sensim ad 3 mm dilatata, deinde paulum contracta et interum dilatata, postea dehiscens in lacinias 5 fissuris omnibus profundis vel singula tantum valde profunda, parte reflexa lanceolata, 5 ad 6 mm longa, 0.75 mm lata, acuta vel obtusa. Filamenti pars libera 2.5 ad 3 mm longa; anthera 1.5 ad 2 mm longa, obtusa, loculis 4 continuis. Stylus filiformis, corolla paulo longior, tota longitudine aequicrassus, sub stigmate tantum paulum attenuatus; stigma paulum incrassatum, stylo subaequicrassum. Cetera ignota.

*Amyema urdanetensis* and *A. leytensis* are too little different to be distinguished as separate species.

LEYTE, Mount Ibuni, back of Dagami, *Bur. Sci. 15243 Ramos* (M, B, L), type of *Loranthus leytensis* Merr., flower yellow. MINDANAO, Agusan Province, Mount Urdaneta, Cabadbaran, 6,000 feet altitude, *Elmer 14092* (M, NY, B, L, Be), cotypes of *Loranthus urdanetensis* Elmer, corolla deep blood red, except the yellow apical segments.

4. **AMYEMA HALCONENSIS** (Merrill) Danser.

*Loranthus halconensis* MERR., Philip. Journ. Sci. § C 2 (1907) 271; 4 (1909) 143 excl. specim.; Enum. Philip. Fl. Pl. 2 (1923) 105 p. p.

*Loranthus pubiflorus* MERR., Philip. Journ. Sci. § C 7 (1912) 263 non Sprague (m. Mart, 1912).

*Loranthus Spraguei* MERR., Philip. Journ. Sci. § C 13 (1918) 279; Enum. Philip. Fl. Pl. 2 (1923) 110.

*Amyema halconensis* and *Spraguei* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 296, 299; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 29, 34.

Glabra, inflorescentiis calicibusque breve densique velutinis et corolla parcius et magis papillose puberula exceptis. Robusta, stolonibus plantae nutrici affixa. Ramuli juniores teretes, nodis incrassatis, internodiis folia adulta ferentibus 7 ad 11 cm longis, 2 ad 7 mm crassis, vetustioribus crassioribus nodis minus incrassatis. Folia verticillata plerumque ad 5 vel 6; petiolus supra basin paulum incrassatam teres, laminam versus sensim applanatus vel excavatus, 5 ad 15 mm longus, 1 ad 2.5 mm crassus; lamina oblongo-lanceolata, 10 ad 18 cm longa, 1.5 ad 7.5 cm lata, basi cuneata vel subrotundata, apice acuta vel obtusa, crassa, fragilis, utrinque opaca, nervature facie superiore parte vel omnis distincta, facie inferiore costa valde prominente nervis ceteris vix visibilibus. Inflorescentiae in nodis defoliatis et in stolonibus, umbellae pedunculatae triadum, floribus omnibus pedicellatis; pedunculus 3 ad 7 mm longus, c. 0.75 mm crassus, apice basique incrassatus, teres; radii c. 8, 1 ad 2.5 mm longi; pedicelli florum mediorum 0.5 ad 0.75 mm longi, lateralium longiores ad 1.5 mm, omnes teretes; bracteae bracteolaeque ovatae, obtusae vel acutae, 0.5 ad 1.5 mm longae. Calicis campanulato-infundibuliformis, 1.5 ad 2 mm longus, apice 1 ad 1.5 mm latus, limbo 0.5 ad 0.75 mm longo indistincte dentato. Corolla statu alabastri adulti 22 ad 32 mm longa, a basi rotundata usque ad duas tertias longitudinis 1 ad 2 mm lata, tum nonnihil ampliata, deinde vix attenuata et iterum in clavam subacutam incrassata, postea dehiscens in lacinias 4.5, vel 6, tubum plerumque 1 ad 2 mm raro longiorem relinquens, laciniis linearibus, parte superiore reflexa 4 ad 6 mm longa lanceolata basi lata apice acuta. Stamina 4 ad 6; filamenti pars libera 0.5 ad 3 mm longa; anthera 2 ad 3 mm longa, obtusa, loculis 4 continuis. Stylus corolla 2 ad 3 mm longior, filiformis, sub stigmate tantum paulum attenuatus; stigma paulum incrassatum, obtusum. Cetera ignota.

*Amyema halconensis* and *A. Spraguei* are too little different to be distinguished as separate species. The flower of this species is said to be yellow.

LUZON, Laguna Province, Paete, low altitude, *F. B. 13086 Curran* (M), type of *Loranthus pubiflorus* Merr. MINDORO, Alag River, Mount Halcon, 100 m altitude, *Merrill 5664* (M, type, NY, Be, cotypes of *Loranthus halconensis*). PANAY, Iloilo Province, Ulian River, *Bur. Sci. 18294 C. B. Robinson* (M): Capiz Province, Libacao, Tagnacan, low altitude, *Bur. Sci. 35459 Martelino and Edaño* (M, Be).

### 5. AMYEMA INCARNATIFLORA (Elmer) Danser.

*Loranthus incarnatus* ELMER, Leafl. Philip. Bot. 3 (1911) non Jack (1824) nec Korth. (1839).

*Loranthus incarnatiflorus* and *L. preslii* ELMER, Leafl. Philip. Bot. 6 (1913) 1969–1970; MERR., Enum. Philip. Fl. Pl. 2 (1923) 105, 109.

*Loranthus Fenicis* and *L. maritimus* MERR., Philip. Journ. Sci. § C 9 (1914) 281, 282; Enum. Philip. Fl. Pl. 2 (1923) 104, 106.

*Amyema incarnatiflora, Fenicis, maritima* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 295–297; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 28–31.

Glabra, inflorescentiis calicibusque brevissime velutinus et corolla parce pilosa exceptis. Ramuli teretes vel subangulati, insertionibus foliorum incrassatis, internodiis inter folia adulta ad 6 cm longis, 1.5 ad 5 mm crassis. Folia sparsa vel ad 2 vel 3 in verticillos conferta; petiolus supra basin saepe paulum incrassatam teres, laminam verus supra late concavus vel subplanus, 5 ad 25 mm longus, 1 ad 2.5 mm crassus; lamina lanceolata ad ovato-cordata, 5 ad 12 cm longa, 2 ad 6.5 cm lata, basi cuneata ad subcordata, apicem acutiusculum versus sensim attenuata vel subacuminata rarius obtusior, crassa, fragilis, utrinque opaca, costa supra plana distincta subtus valde prominente, nervis ceteris supra indistinctis vel invisibilibus, subtus subinvisibilibus. Inflorescentiae umbellae pedunculatae triadum omnibus floribus sessilibus, singulae in axilis vel in nodis defoliatis, vel in stolonibus; pedunculus 10 ad 26 mm longus, teres, 1 ad 1.25 mm crassus, basi paulum incrassatus, apice in capitulum radiis omnino tectum incrassatus; radii 15 ad 30, rarius pauciores, teretes 1 ad 6 mm longi; bracteae bracteolaeque ovato-triangulares, acutae vel obtusae, 0.5 ad 1.5 mm longae. Calicis campanulato-infundibuliformis vel paulum ovatus, 2.25 ad 3 mm longus, apice 1.75 mm latus, limbo brevissimo vel ad 0.75 mm longo, integro vel irregulariter brevissime dendato; corolla 25 ad 30 mm longa, statu alabastri adulti supra partem basalem 1.5 ad 2 mm latam subcylindricam pauca mm longam sensim usque ad duas tertias longitudinis dilatata, deinde paulum attenuata denique in clavam obtusam incrassata, postea usque ad pauca mm supra basin dehiscens in lacinia 5 parte superiore reflexa 4 ad 6 mm longa lanceolata-spathulata, apice acutiuscula paulum incrassata. Filamenti pars libera 3 ad 5 mm longa; anthera oblonga obtusissima, 1.5 ad 2.5 mm longa, loculis 4 continuis, basi cum filamento subarticulata. Stylus filiformis, sub stigmate vix attenuatus, corolla c. 4 mm longior; stigma styli apice vix crassius, obtusissimum. Cetera ignota.

In my opinion, *Loranthus incarnatiflorus, Preslii, Fenicis,* and *maritima* are too little different to be distinguished as separate species. Though the types of the four species united by me are somewhat different, the resulting species is less polymorphic than several of the genus such as *A. Haenkeana.* It is known to grow at different altitudes, from sea level to 1,725 m elevation, and this may be one of the causes of its relative polymorphy. The distribution is chiefly in Mindanao, but it has been collected in northern Luzon. The color of its corolla is said to be red in different hues, entirely so or with green apices of the corolla limbs.

LUZON, Ilocos Sur Province, Tagudin, *Bur. Sci. 10081 McGregor* (M). MINDANAO, Surigao Province, Tamanao, seashore, *Bur. Sci. 15824 Fénix* (M, type, Be, cotype, of *Loranthus maritimus* Merr.): Agusan Province, Mount Urdaneta (Cabadbaran), 1,725 m altitude, *Elmer 1374* (M, UC, NY, B, L, U, Be, cotypes of *Loranthus Preslii* Elm.): Davao Province, Mount Apo, Todaya, 1,350 m altitude, *Elmer 11817* (M, NY, B, L, U, Be, cotypes of *Loranthus incarnatus* or *L. incarnatiflorus* Elm.); Baganggo, *Bur. Sci. 15852 Fénix* (M), type of *Loranthus Fenicis* Merr.; Mount Mayo, 600 m, *Bur. Sci. 49412 Ramos and Edaño* (M, UC, NY): Lanao Province, Camp Keithley, Lake Lanao, *Clemens s. n.* (M, Be).

**6. AMYEMA LUZONENSIS (Schulten) Danser.**

*Loranthus luzonensis* SCHULT., Syst. 7 1 (1829) 104; DC., Prodr. 4 (1830) 295; BLUME, in Schult., Syst. 7 2 (1830) 1612, 1730; Fl. Javae, Lor. (1830) 14; DIETR., Syn. 2 (1840) 1075; ETTINGSH., Denkschr. Akad. Wiss. Wien. Math.-Naturwiss. Cl. 32 (1872) 53; BENTH. and HOOK. F., Gen. Pl. 3 (1880) 208; FER.-VILL., Nov. App. (1880) 183; VIDAL, Pl. Cuming. Philip. (1885) 77, 140; Rev. Pl. Vasc. Fil. (1886) 232; ENGL., in Engl. and Pr., Nat. Pfl. fam. 3 1 (1889) 185, 188; VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1885) 253; ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 128; MERR., Philip. Journ. Sci. § C 4 (1909) 135; Enum. Philip. Fl. Pl. 2 (1923) 106.

*Dendrophthoe luzonensis* G. DON, Gen. Hist. Dichl. Pl. 3 (1834) 419; MIQ., Fl. Ind. Bat. 1 1 (1856) 818; ETTINGSH., Denkschr. Akad. Wiss. Wien, Math.-Naturwiss. Cl. 32 (1872) 66.

*Stemmatophyllum luzonense* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 505, 506, 546.

*Amyema luzonensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 296 excl. synon.; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 31.

Subgracilis, stolonibus plantae nutrici affixa, ramosissima, dichotoma passim trichotoma; inflorescentiis floribusque juventute dense, calicibus exceptis postea minus dense velutinis, ceterum glabra. Ramuli teretes nodis valde incrassatis, internodiis inter folia adulta 1 ad 6 cm longis, 0.75 ad 2 mm crassis, nodis circiter duplo crassioribus. Folia quaternata verticillata, sessilia, oblonga ad obovata, 1 ad 6 cm longa, 0.8 ad 2 cm lata, basi anguste rotundata, apice late rotundata, in herbario crassa duraque, utrinque opaca, fragilia, facie inferiore plerumque costa tantum visibili, facie superiore nervis omnibus invisibilibus vel costa et nervis lateralibus crassioribus indistinctis. Inflorescentiae singulae in axillis foliorum, et paucae ad nodos nuper defoliatos, umbellae pedunculatae triadum floribus omnibus pedicellatis; pedunculus teres, apice basique paulum incrassatus, 7 ad 30 longus, medio c. 0.5 ad 0.75 mm crassus; radii plerumque 4, rarius 2 vel 3 vel ad 7, teretes, 1 ad 4 mm longi, 0.25 ad 0.35 mm crassi; pedicelli florum lateralium iam subaequales, iam longitudine differentes, teretes, 0.5 ad 2 mm longi, florum mediorum nonnunquam fere nulli; bracteae omnes ad basin calicis insertae, ovatae semiamplexicaules, 0.5 ad 2 mm longae, obtusae vel acutae vel acuminatae. Calicis tubus subcylindricus, paulum infundibuliformis, 2 ad 2.5 mm longus, apice c. 1 mm latus, limbus infundibuliformis vel cupuliformis lobis brevibus obtusis vel integer, 0.75 ad 1 mm longus. Corolla statu alabastri adulti longe cylindrica, 25 ad 38 mm longa, 1 ad 2 mm lata, cylin-

drica, parte superiore 6 ad 8 mm longa anguste ellipsoidea sesquiplo crassiore excepta, apice plerumque obtusa rarius acuta vel breve acuminata, postea dehiscens in petala 4 lineares parte superiore 5 ad 7 mm longa reflexa paulo latiore. Filamenti pars libera 0.5 ad 3 mm longa; anthera 2 ad 4 mm longa, apicem obtusiusculum versus angustata, loculis 4 continuis. Stylus filiformis, corolla 1 ad 2 mm longior (ad 40 mm longa), sub stigmate tantum paulum attenuata; stigma stylo aequicrassum, obtusissimum. Fructus ellipsoides, vel subpiriformis, 6 mm longus 4 mm diametro, calicis limbo erecto vel infundibuliformi 1.5 mm longo coronatus.

*Amyema luzonensis* is, with certainty, collected in Luzon only, but is widely spread in this island at low and medium altitudes (up to 900 m). The color of its corolla indicated in the herbarium labels is yellow or orange-yellow, sometimes partly red, or green at the tip.

Philippines, without exact locality, *Cuming 490* (L); *1964* (M, NY, L, Be); *1956* (M), cotype of *Stemmatophyllum sessilifolium* Van Tiegh.? LUZON, Ilocos Norte Province, Bonbon, *Bur. Sci. 7665 Ramos* (B. L.); Bangui, *Bur. Sci. 43587 McGregor* (M, UC, Be), *Bur. Sci. 27650 Ramos* (M, UC, B); Burgos, low altitude, *Bur. Sci. 32878 Ramos* (M, NY, B, S, L): Ilocos Sur Province, San Esteban, *Clemens 17854 bis* (UC, B, S): Abra Province, no locality, *Bur. Sci. 7250 Ramos* (M); Lagayan, 50 m altitude, *F. B. 23995 De la Peña* (M, B): La Union Province, Bauang, *Elmer 5693* (M, NY, B, S, Be): Mountain Province, Benguet, *F. B. 15893 Bacani* (M); 900 m altitude, *F. B. 10922 Curran* (N, NY, B, L, Be): Zambales Province, *F. B. 5927 Curran* (M, NY, Be); Botulan, *Warburg 13324* (Be); Maracapas, *F. B. 11050 Zschokke* (M, NY), with *Viscum articulatum;* Anulig, low altitude, *Bur. Sci. 44569 Ramos and Edaño* (M, UC): Bataan Province, Limay, *F. B. 19137 Curran* (M); Mount Limay, 40 to 50 m, *Bur. Sci. 10851 Foxworthy* (M). MINDANAO, without exact locality, very imperfect materials, hence very doubtful as to the locality, *Schadenberg s. n.* (Br).

### 7. AMYEMA BENGUETENSIS (Merrill) Danser.

*Loranthus benguetensis* MERR., Philip. Journ. Sci. § C 4 (1909) 134; MERR. and MERRITT, Philip. Journ. Sci. § C 5 (1910) 345; MERR., Enum. Philip. Fl. Pl. 2 (1923) 103.

*Amyema benguetensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 294; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 26.

Stolonibus plantae nutrici affixa, subgracilis, valde ramosa, plerumque dichotoma, omnis glabra. Ramuli teretes nodis incrassatis; internodia inter folia adulta 1 ad 5 cm longa, 1 ad 2.5 mm crassa, nodis duplo vel triplo crassioribus. Folia quaternata verticillata, sessilia, plerumque oblonga ad obovata, raro suborbicularia vel lanceolata, 1 ad 4.5 cm longa, 0.5 ad 1.8 cm lata, basi anguste rotundata vel acuta, apice rotundata, crassiuscula et fragilia, utrinque opaca vel facie superiore sublucida, costa facie inferiore tantum distincta, nonnunquam costa et nervi crassiores facie superiore indistincti. Inflorescentiae umbellae pedunculatae triadum plerumque 4, saepe 2 vel 3, raro vel 6, floribus omnibus pedicellatis, singulae in axillis foliorum adultorum vel nuper delapsorum; pedunculus 10 ad 20 mm longus, 0.3 ad 0.5 mm crassus, teres, apice basique leviter incrassatus; radii 1.5 ad 4 mm longi, teretes 0.25 mm crassi; pedicelli florum lateralium 1 ad 2 mm longi, florum mediorum aequilongi vel breviores, raro subnulli; bracteae ovatae plerumque acutae, c. 0.75 mm longi. Calicis tubus infundibuliformis vel obovatus, c. 2 mm longus apice 1 mm latus; limbus 0.5 ad 0.75 mm longus, integer vel subinteger, infundibuliformis. Corolla statu alabastri adulti subcylindrica, 13 ad 20 mm longa, 1 mm lata, parte superiore 6 mm longa paulo crassior, apicem subacutam versus conice attenuata, postea dehiscens in petala 5 (?) linearia, 0.8 mm lata, parte superiore 5 mm longa reflexa, anguste triangula obtusiuscula. Filamenti pars libera brevissima, 0.25 ad 0.5 longa; anthera 2 ad 2.5 mm longa, obtusa. Stylus filiformis, sub stigmate vix attenuata, corolla paulo longior; stigma styli apice paulo crassius, obtusissimum. Cetera ignota.

Restricted to the mountains of northern Luzon, and apparently parasitic only on *Pinus insularis*, at an altitude of 1,200 to 1,600 m. Father Vanoverbergh describes the flowers as yellow in the lower portion, red in the upper.

LUZON, Mountain Province, Benguet, *Bur. Sci. 2712 Mearns* (M, Be); Baguio, *Williams 1989* (NY); Mount Pulog, 1,200 m, *F. B. 16064 Curran, Merritt, and Zschokke* (M, NY, Be), type of *Loranthus benguetensis* Merr.; Bontoc, 1,500 to 1,600 m, *Vanoverbergh 1098* (M, Be).

8. **AMYEMA ACUTA** (Van Tieghem) Danser.

*Stemmatophyllum acutum* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 546.

*Loranthus acutus* ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 128; MERR., Philip. Journ. Sci. § C 4 (1909) 135; Enum. Philip. Fl. Pl. 2 (1923) 102.

*Amyema acuta* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 293; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 25.

Stolonibus plantae nutrici affixa; ramosissima, plerumque dichotoma, rarius 3- ad 5-chotoma; glabra, inflorescentiis, calicibus et corollis juvenilibus dense puberulis exceptis. Ramuli teretes, nodis incrassatis, internodiis folia adulta ferentibus 3 ad 10 cm longis, 1 ad 2.5 mm crassis, nodis ad duplo crassioribus. Folia verticillata plerumque quaternata rarius ad apices ramulorum opposita; petiolus subtus rotundatus supra plana vel leviter canaliculata, basi paulum incrassatus, difficile a lamina distinguendus, 3 ad 13 mm longus, 1 ad 1.5 mm latus; lamina oblonga vel ovato-oblonga ad lanceolata vel ovato-lanceolata vel ovato-lanceolata, 4 ad 12 cm long, 1 ad 4 cm lata, basi plerumque in petiolum attenuata raro rotundata, apicem obtusum vel obtusiusculum versus plerumque acuta vel acuminata, crassiuscula, subfragilis, utraque facie opaca, penninervis, facie inferiore costa valde prominente nervisque lateralibus vix visibilibus vel omnino invisibilibus, facie superiore costa impressa nervis ceteris invisibilibus. Inflorescentiae gregatim circa nodos foliatos vetustiores et nodos defoliatos, in scrobiculis corticis insertae, umbellae pedunculatae triadum plerumque 4, floribus omnibus pedicellatis; pedunculus teres basi clavatim incrassatus, 6 ad 20 mm longus, 0.5 ad 0.75 mm crassus; radii teretes, 1 ad 5 mm longi, 0.25 ad 0.35 mm crassi; pedicelli teretes, florum lateralium 1.5 ad 2 mm longi, mediorum 0.75 ad 1 mm longi; bracteae florum omnium ad basin calicis insertae, ovatae convexae semiamplexicaules, obtusae vel acutae, 0.75 ad 1 mm longae. Calicis tubus obovato-infundibuliformis, 1.5 ad 2.5 mm longus, 1 ad 1.25 mm latus, limbus brevis, 0.25 mm longus vel etiam brevior, integer vel indistincte irregulariterque dentatus, erectus vel cupuliformis. Corolla statu alabastri adulti 17 ad 25 mm longa, ad 4 ad 5 mm ab apice leviter constricta, sub constrictione ad 2 ad 3 mm dilatata, supra constrictionem ellipsoides paulum incrassata, obtusissima, postea dehiscens in petala 4 vel 5 parte infra constictionem lineari c. 1.25 mm lata, parte superiore 5 mm longa reflexa lingulata 0.75 ad 1 mm lata obtusa. Filamenti pars libera c. 2.5 ad 3 mm longa; anthera 2 ad 3 mm longa c. 0.5 mm lata obtusissima, loculis 4 continuis. Stylus corolla subaequilongus, filiformis, prope stigma paulo tenuior, sulcis longitudinalibus 5 vel 4; stigma styli apice vix crassius, obtusum.

Fructus ellipsoides vel paulum obovatus, ad 8 mm longus 5 mm diametro, calicis limbo erecto incrassato coronatus.

*Amyema acuta* appears to occur in northern and central Luzon only, and to be common there at medium and high altitudes (780 to 2,400 m). The color of its corolla is indicated on the herbarium labels as red, or orange, or yellow, or red in the lower portion, and yellow, orange, or yellowish green in the upper; the color of the fruit is once indicated as red.

Philippine Islands, without exact locality, *Cuming 1973* (M), cotype of *Stemmatophyllum acutum* Van Tiegh. LUZON, Cagayan Province, Mount Balatongan, summit, 780 m altitude, *Bur. Sci. 78511 Edaño* (M): Mountain Province, Benguet, Baguio, *Elmer 8640* (NY, B, L); *Williams 1021* (M, NY), *1022* (NY); 1,300 m altitude, *Merrill 9701* (M); 1,200 m altitude, *Bur. Sci. 45036 Ramos and Edaño* (M, UC, NY), 1,770 m altitude, *F. B. 15982 Bacani* (M, Be), behind Easter School, *Clemens 16452* (M, UC, NY), *5887* (UC) Busol Forest Reserve, 1,500 m altitude, *F. B. 31368 Esguerra* (M, NY); Baguio to Ambuklao, Trinidad, *Williams 1319* (M, NY), *Elmer 5809* (M, NY, Be); Mountain Trail, Km 8–10, *Bur. Sci. 78109 Quisumbing* (M); 1,350 m altitude, *Bur. Sci. 45169 Ramos and Edaño* (M, NY, B, S); Mount Santo Tomas, 2,280 m altitude, *Bur. Sci. 82286 Quisumbing* (M); Bauco, 1,290 m altitude, *Vanoverbergh 221* (M, L), 1,750 m altitude, *Vanoverbergh 1782* (M); Pauai, 2,400 mm altitude, *Bur. Sci. 31867 Santos* (M, UC); Ifugao Subprovince, Mount Polis, *Bur. Sci. 19836 McGregor* (M): Nueva Ecija Province, *F. B. 22439 Alvarez* (M, L): Rizal Province, *Loher 13952* (M, B), *14267* (M, UC); Montalban, *Loher 12342* (M, UC), *12791* (M); Mount Lumutan, 930 m altitude, *Bur. Sci. 42150 Ramos* (M); Mount Irig, 1,230 m altitude, *Bur. Sci. 42193 Ramos* (M, S).

### 9. AMYEMA MEDINILLICOLA (Merrill) Danser.

*Loranthus medinillicola* MERR., Philip. Journ. Sci. § C 9 (1914) 287; Enum. Philip. Fl. Pl. 2 (1923) 106.

*Amyema medinillicola* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 297; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 31.

Stolonibus plantae nutrici affixa; glabra, floribus inflorescentiisque breve velutinis exceptis, indumento calicis permanente, ceterum tenuescente. Ramuli graciles simplices, teretes, internodiis 1 ad 4, 1 ad 5 cm longis, 1.5 ad 3 mm crassis, nodis sesquiplo vel duplo crassioribus. Folia verticillata quaternata; petiolus supra planus vel caniculatus, subtus rotundatus, 3 ad 5 mm longus, 0.75 ad 1 mm crassus; lamina lanceolata, 5 ad 10 cm longa, 1 ad 3 cm lata, basi in petiolum contracta vel attenuata, apicem obtusiusculum versus acuminata, crassiuscula, fragilis, utrinque opaca, costa facie inferiore prominente, superiore plana distincta, nervis ceteris invisibilibus vel crassioribus utrinque indistinctis. Inflorescentiae e stolonibus et (testibus cicatricibus) ex axillis foliorum vetustiorum procrescentes, umbellae pedunculatae triadum 4, floribus omnibus pedicellatis; pedunculus 17 mm longus, c. 0.75 mm crassus, basi apiceque incrassatus; radii 4, 1 ad 2 mm longi, c. 0.4 mm crassi; pedicelli florum lateralium 1.5 ad 2 mm longi, mediorum c. 1 mm longi; bracteae c. 1 mm longae, ovatae, acutae. Calicis tubus 1.5 mm longus, campanulato-infundibuliformis, apice 1 mm latus; limbus 0.5 ad 0.75 mm longus, infundibuliformis, integer vel levissime dentatus. Corolla petalis 4 linearibus, 28 mm longis a basi ad apicem paulum dilatatis medio c. 1.5 mm latis parte superiore 7 mm longa reflexa lingulata obtusa. Filamenti pars libera 3 mm longa; anthera c. 3.5 mm longa a basi ad apicem subacutum sensim attenuata, loculis 4 continuis. Stylus filiformis, in paucis mm superioribus paulum attenuatus; stigma stylo aequicrassum, obtusissimum. Cetera ignota.

*Amyema medinillicola* has the foliage of *A. acuta,* and the flowers and inflorescences of *A. luzonensis.* The general habit of the type specimen is peculiar, as from long slender creepers originate the short unbranched stems and the inflorescences; this, however, may later prove to be only the case in weak specimens that are not well attached to the host plant. The same uncommon habit was shown by the type specimen of *Amyema celebica;* stronger specimens of the same species proved to have a normal habit.

LUZON, Mountain Province, Ifugao, Mount Polis, mossy forest, *Bur. Sci. 19842 McGregor* (M), type, flower bright yellow, reddish toward base, fruit white.

10. **AMYEMA MOSEA** Danser sp. nov. Plate 1, figs. 5 to 7.

Omnis glabra, subgracilis. Stolonibus plantae nutrici affixa. Ramuli parce ramosi, internodiis teretibus, folia adulta ferentibus 2.5 ad 8 cm longis, 1 ad 2 mm crassis, nodis ad duplo crassioribus. Folia verticillata quaternata; petiolus basi teres paulum incrassatus, laminam versus supra paulum applanatus, 6 ad 10 mm longus, 0.75 ad 1 mm crassus; lamina lanceolata, 4.5 ad 8 cm longa, 1 ad 2 cm lata, basi sensim in petiolum attenuata, apicem obtusiusculum versus acuta vel paulum acuminata, crassiuscula, in herbario coriacea, fragilis, utrinque opaca, facie inferiore costa paulum prominente nervis lateralibus leviter coloratis, facie superiore omnibus nervis invisibilibus. Inflorescentiae singulae in axillis defoliatis, umbellae pedunculatae triadum 2 vel 3, floribus omnibus pedicellatis; pedunculus teres, basi paulum dilatatus, 3 ad 5 mm longus, 0.3 ad 0.5 mm crassus, post anthesim ad 7 mm elongatus ad 0.65 mm incrassatus; radii 2 vel 3 teretes, 1 ad 1.5 mm longi; pedicelli florum lateralium paulo longiores quam 0.5 mm, mediorum paulo breviores quam 0.5 mm, teretes; bracteae ovatae semiamplexicaules, obtusae vel acutiusculae, 0.5 ad 0.75 mm longae, semper ad basin calicis insertae. Calicis tubus infundibuliformi-obovatus, 1.25 ad 1.5 mm longus, apice 1 mm latus, limbus infundibuliformis vel cupulatus, c. 0.5 mm longus, integer vel levissime dentatus. Corolla statu alabastri adulti subcylindrica c. 20 mm longa ad duas tertias paulum dilatata ibi 2.5 mm lata, parte superiore 3.5 mm longa versus apicem obtusum conica, postea dehiscens in petala 4 linearia, e basi rotundata usque ad 3.5 mm ad apice c. 2 mm lata, parte superiore triangulari obtusa. Antherae subsessiles, oblongae, c. 3 mm longae obtusae. Stylus filiformis, c. 22 mm longus, sub stigmate paulum attenuatus; stigma subglobosum, obtusissimum, stylo aequicrassum. Cetera ignota.

The specific name of this species is from Moses (Span.: Moisés), the Hebrew lawgiver, as the type was collected on the summit of Mount Moises. The description is after the type only. The second specimen mentioned is different by stems somewhat coarser, leaves somewhat broader, 2 to 4 mm broad and without colored nerves, the peduncle somewhat longer, after flowering up to 8 mm long, the umbel rays up to 2 mm, the pedicels of the lateral flowers up to 1 mm long, the filaments nearly 1.5 mm long, the anthers nearly 2 mm, the style shorter, 16 to 18 mm long.

LUZON, Isabela Province, Mount Moises, near summit, 1,050 m altitude, *Bur. Sci. 47338 Ramos and Edaño* (M, type, UC, NY), flower yellow, type: Mountain Province, Bontoc, Mount Polis, 600 m altitude, *Bur. Sci. 37700 Ramos and Edaño* (M, L, Be), flower yellow.

**11. AMYEMA VERTICILLATA (Merrill) Danser.**

*Cleistoloranthus verticillatus* MERR., Philip. Journ. Sci. § C 4 (1909) 150; MERR. and MERRITT, Philip. Journ. Sci. § C 5 (1910) 345; KRAUSE, in Engl. and Pr., Nat. Pfl. fam. Nacht. 4 zu 2–4 (1915) 73.

*Loranthus appendiculatus* MERR., Philip. Journ. Sci. § C 7 (1912) 78; Enum. Philip. Fl. Pl. 2 (1923) 102.

*Amyema verticillata* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 299; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 34.

Omnis glabra. Ramuli teretes, nodis incrassatis, internodiis folia adulta ferentibus 2 ad 8 cm longis, 1 ad 1.25 cm crassis, nodis sesquiplo ad duplo crassioribus. Folia verticillata quaternata; petiolus supra plana subtus rotundata, basi paulum incrassatus, difficile a lamina distinguendus, 3 ad 10 mm longus, 0.5 ad 1 mm crassus; lamina oblongo-lanceolata, 3 ad 8 cm longa, 1 ad 3 cm lata, basi cuneata vel magis in petiolum attenuata, maxima latitudine circa medium, apicem obtusiusculum versus acuta vel acuminata, tenuiter coriacea, fragilis, opacissima, penninervis, nervis lateralibus incurvatis costa supra plana plerumque indistinctissima, subtus prominente, nervis ceteris utraque facie invisibilibus vel crassioribus indistinctis. Inflorescentiae umbellae triadum 4 pedunculatarum, floribus lateralibus pedicellatis mediis subsessilibus, singulae in axillis foliorum vetustiorum vel gregatim in nodis defoliatis; pedunculus basi apiceque paulum incrassatus ceterum teres, 10 ad 15 mm longus, 0.5 mm crassus; radii teretes, 5 ad 7 mm longi, 0.5 ad 0.3 mm crassi; pedicelli florum lateralium 1 ad 1.5 mm longi, mediorum nulli vel subnulli; bracteae ovatae subsemiamplexicaules, acutae del obtusae, c. 1.5 mm longae saepe paulo irregulariter incisae. Calicis tubus breve campanulatus subobovatus, c. 1.5 mm longus et latus; limbus erectus, margine irregulariter fibrosus, c. 0.25 ad 0.5 mm longus. Corolla statu alabastri adulti 13 ad 14 mm longa, parte inferiore 10 mm longa cylindrica 1.25 ad 1.5 lata, supra eam partem primum paulum attenuata deinde incrassata in clavam obtusissimam, prope apicem verticillo appendicum dorsalium late cuneatarum apicibus irregulariter incisarum vel nonnunquam bilobarum 0.5 mm longarum ornatam, postea partita in petala 4 linearia, e basi ad apicem paululum dilatata, c. 1 mm lata. Filamenti pars libera 3.5 mm longa; anthera ovata, c. 1.25 mm longa, obtusa, loculis 4 continuis. Stylus vix longior quam corolla, filiformis, sub stigmate paulum attenuatus;

stigma stylo aequicrassum, obtusissimum. Fructus ellipsoides, 6 mm longus 5 mm crassus, calicis limbo permanente erecto coronatus.

Merrill[3] considers the dorsal appendages of the petals as the tips, the tips as ventral appendages. That this is wrong is shown by the fact that the dorsal appendages never are closed in bud, and that similar appendages also occur in *Macrosolen curtiflorus* and in several species of the African genus *Tapinanthus*.

*Amyema verticillata* is restricted to northern Luzon and occurs there at higher altitudes (1,670 to 2,500 m). On the labels the color of the flower is indicated as pink or red, the fruit as red.

LUZON, Mountain Province, Benguet, Mount Pulog, 2,500 m altitude, *F. B. 16229 Curran, Merritt, and Zschokke* (M, Be), type of *Cleistoloranthus verticillatus* Merr., 2,400 m altitude, *Bur. Sci. 44928* (NY, UC, B) and *44934* (M, UC, S, B) *Ramos and Edaño,* 2,100 m altitude, *Bur. Sci. 44978 Ramos and Edaño* (M, UC); Mount Osdung, 2,300 m, *Bur. Sci. 82502 Quisumbing and Sulit* (M); Bontoc Subprovince, Malamey, Pinggat, 1,670 m altitude, *Vanoverbergh 1293* (M, Be).

### 12. AMYEMA CELEBICA (Van Tieghem) Danser.

*Rhizanthemum celebicum* and *Forsteni* VAN TIEGHEM, in Morot, Journ. de Bot. 15 (1901) 364.

*Loranthus bicoloratus* ELM., Leafl. Philip. Bot. 2 (1908) 470; MERR., Philip. Journ. Sci. § C 4 (1909) 137; Enum. Philip. Fl. Pl. 2 (1923) 103.

*Loranthus lanaensis* MERR., Philip. Journ. Sci. § C 4 (1909) 136; Enum. Philip. Fl. Pl. 2 (1923) 105.

*Amyema celebica* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 294; 11 (1931) 328; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 27.

*Amyema lanaensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 296; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 30.

Omnis glabra; stolonibus plantae nutrici affixa. Ramuli subrobusti dichotomi, internodiis teretibus apicem versus paulum incrassatis et applanatis, folia adulta ferentibus ad 10 cm longis, 2.5 ad 5 mm crassis. Folia plerumque opposita rarius sparsa vel passim verticillata quaternata; petiolus robustus supra basin paulum incrassatam teres laminam versus supra plana vel sub-canaliculata, 10 ad 22 mm longus, 2 ad 3 mm latus, difficile a lamina distinguendus; lamina ovato-oblonga ad lanceolata, 9 ad 20 cm longa, 3 ad 7 cm lata, basi in petiolum attenuata, apicem obtusiusculum versus leviter acuminata, crasse coriacea, utraque facie opaca, penninervis, costa supra plana distincta, subtus valde prominente, nervis lateralibus crassioribus utraque facie indistinctis, venis tenuioribus invisibilibus. Inflorescentiae umbellae pedunculatae triadum plerumque 4 rarius 3 vel 2, floribus omnibus pedicellatis, paucae in axillis defoliatis vel passim in stolonibus; pedunculus teres, basi clavatus, 5 ad 17 mm longus, 0.3 ad 0.5 mm crassus; radii teretes, 2 ad 4 mm longi; pedicelli teretes, 2 ad 4 mm longi, florum lateralium paulo longiores quam florum mediorum; bracteae omnes ad basin calicis, ovatae, obtusae, semiamplexicaules, 0.75 ad 1 mm longae. Calicis tubus infundibuliformis vel paulum obovatus vel pyriformis, c. 3 mm longus apice 1.5 mm latus; limbus infundibuliformis, integer, 1.25 mm longus. Corolla statu alabastri adulti subcylindrica, 27 ad 32 mm longa, a basi ad medium dilatata ad 2.5 mm lata, deinde angustata, ad 6 ad 9 mm ab apice c. 1.5 mm lata, parte superiore in clavam ellipsoidem acuminatam incrassata, postea dehiscens in petala 5 linearia, parte superiore 6 ad 9 mm longa reflexa, subacuta. Filamenti pars libera 3 mm longa; anthera 2.5 ad 3.5 mm longa, subobtusa, loculis 4 continuis. Stylus 1 ad 3 mm longior quam corolla, in 2 mm superiora paulum attenuatus; stigma paulo crassius quam styli apex, obtusissimum. Fructus obovatus, c. 9 mm longus, 6 ad 7 mm crassus.

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[3] Philip. Journ. Sci. § C 4 (1909) 150; § C 7 (1912) 78–79.

*Amyema celebica* has been collected in Negros and Mindanao, and south of the Philippines in Karakelang and Celebes, at low and medium altitudes. The specimens enumerated below as doubtful seem to be transition forms to *Amyema basilanensis*, and I should have united the latter species with *A. celebica*, if on these materials flowers were not nearly absent. Probably *Amyema basilanensis* is only a small-flowered form of *A. celebica*, and then the number *Wenzel 3197*, cited as doubtful under *A. basilanensis*, also belongs to the intermediate forms.

The corolla of *A. celebica* is indicated on herbarium labels as yellow or red, with green or yellowish green tips.

NEGROS, Oriental Negros Province, Cuernos Mountains, Dumaguete, 760 m altitude, *Elmer 9550* (M, NY, B, L), cotypes of *Loranthus bicoloratus* Elmer. MINDANAO, Lanao Province, Lake Lanao, Camp Keithley, *Clemens 777* (M, type, B, Be, cotypes of

*Loranthus lanaensis* Merr.): Agusan Province, Butuan, Bunaoan, Tigpon River, 15 m altitude, *Weber 1033* (M): Surigao Province, low altitude, *Bur. Sci. 34507 Ramos and Pascasio* (M, NY, B, L, S, Be); Lake Mainit, *Bur. Sci. 83432 Ramos and Convocar* (M), *Loher s. n.* (UC).

Doubtful specimens: MINDANAO, Surigao Province, *Wenzel s. n.* (M); Placer, 150 m altitude, *Wenzel 2678* (M, UC, B), *2851* (M); *3049* (M, UC) *3153* (UC), *3176* (UC, B): Davao Province, Davao, *Copeland 376* (M, NY, Be).

Further distribution: Karakelang and Celebes.

### 13. AMYEMA BASILANENSIS (Merrill) Danser.

*Loranthus basilanensis* MERR., Philip. Journ. Sci. § C 4 (1909) 134; Enum. Philip. Fl. Pl. 2 (1923) 102.

*Amyema basilanensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 294; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 26.

Omnis glabra; stolonibus plantae nutrici affixa. Ramuli subrobusti dichotomi, internodiis teretibus nodis incrassatis, folia adulta ferentibus ad 11 cm longis, 2.5 ad 5 mm crassis, nodis ad sesquiplo crassioribus. Folia sparsa saepe subverticillata; pertiolus e basi tereti versus laminam supra canaliculatus, subtus rotundatus, 7 ad 15 cm longus, 1 ad 2.5 mm crassus; lamina oblonga, 5 ad 12 cm longa, 3 ad 5 cm lata, e basi cuneata vel rotundata in petiolum contracta, apicem obtusiusculum versus plerumque breve acuminata, crasse coriacea, utraque facie opaca, costa supra plana distincta subtus valde prominente, nervis lateralibus utrinque vix visibilibus. Inflorescentiae umbellae pedunculatae triadum 4, floribus omnibus pedicellatis, paucae in axillis foliorum vel gregatim in nodis defoliatis, passim etiam in stolonibus, in scrobiculis corticis insertae; pedunculus teres, basi apiceque paulum incrassatus, 2 ad 6 mm longus c. 0.6 mm crassus; radii teretes, 0.5 ad 2 mm longi, c. 0.3 mm crassi; pedicelli florum mediorum 0.5 ad 1 mm longi, lateralium 0.75 ad 1 mm longi; bracteae ovatae, obtusae, 0.5 ad 0.7 mm longae, semiamplexicaules. Calicis tubus infundibuliformis vel paulum piriformis, c. 1.5 ad 2 mm longus, apice 1 mm latus; limbus infundibuliformis vel erectus, integer c. 0.6 mm longus. Corolla statu alabastri adulti c. 17 mm longa, subcylindrica, a basi ad medium ad 1.5 mm dilatata, ad c. 3 mm sub apice paulum constricta, parte superiore ellipsoides obtusiuscula vel subacuminata, postea dehiscens in petala 5 sublinearia obtusiuscula, 3 mm ab apice reflexa. Filamenti pars libera 0.5 mm longa; anthera 2.5 mm longa, obtusa, loculis 4 continuis. Stylus c. 18 mm longus, filiformis, sub stigmate paulum attenuatus; stigma ellipsoides obtusum, stylo paulo crassius. Cetera ignota.

*Amyema basilanensis* probably is a small-flowered form of *A. celebica*, the doubtful specimen mentioned below, and the doubtful ones enumerated under *A. celebica*, forming a number of intermediate forms. The above description is made after the type and the specimens collected by Hallier in Basilan, which are without any doubt specifically identical. The specimen from Placer, *Wenzel 3197*, has narrower leaves, 1.5 to 5 cm broad; thinner peduncles, about 0.5 mm thick; umbel rays longer, 3 to 4 mm long; central flowers of the triads nearly sessile; lateral flowers with pedicels nearly 3 mm long; bracts nearly 1.25 mm long, obtuse or acute; corolla 17 to 19 mm long; style 18 to 22 mm long.

BASILAN, *Hallier 439* (M, NY); Moro, Point Matangal, 3 m altitude, *F. B. 3447 Hutchinson* (M), flower yellow, type of *Loranthus basilanensis* Merr.

Doubtful specimen: MINDANAO, Surigao Province, Placer, 150 m altitude, *Wenzel 3197* (M, UC, NY, B).

### 14. AMYEMA POLILLENSIS (C. B. Robinson) Danser.

*Loranthus polillensis* C. B. ROBINSON, Philip. Journ. Sci. § C 6 (1911) 200; MERR., Enum. Philip. Fl. Pl. 2 (1923) 109.

*Amyema polillensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 298; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 32.

Omnis glabra. Ramuli subrobusti, internodiis teretibus, nodis incrassatis, folia adulta ferentibus 4 ad 8 cm longis, 3 ad 6 mm crassis, nodis fere duplo crassioribus. Folia verticillata, 5 ad 7 nata; petiolus supra basin paulum incrassatam teres, laminam versus supra leviter canaliculatus, 10 ad 20 mm longus, 1.25 ad 2 mm crassus; lamina elliptica vel oblonga, basi acuta vel paulum in petiolum contracta, apicem obtusiusculum vel acutum versus acuta vel acuminata, crasse coriacea, fragilis, utraque facie opacissima, costa supra plana distincta, subtus valde prominente nervis lateralibus crassioribus utrinque indistinctis vel invisilibus. Inflorescentiæ passim singulae in axillis foliorum et gregatim in axillis foliorum vetustiorum et in nodis defoliatis, umbellae simplices pedunculatae floribus 4 ad 6; pedunculus teres, basin versus sensim, apicem versus abrupte incrassatus, 8 ad 11 mm longus, 0.3 ad 0.5 mm crassus; pedicelli teretes, c. 0.3 mm crassi; bracteae late ovatae acutae vel obtusae, semiamplexicaules, c. 1 mm longae. Calicis tubus infundibuliformis vel obovatus, 2 ad 2.5 mm longus, apice c. 1.5 mm latus; limbus infundibuliformis vel cupuliformis, integer, c. 0.5 and 0.75 mm longus; corolla dehiscens in petala 5 sublinearia, 21 ad 23 mm longa, parte superiore c. 5 mm longa reflexa. Filamenti pars libera 1 mm (2 mm ex Robinson) longa; anthera 2.5 mm longa, loculis 4 continuis, obtusa. Stylus 23 ad 25 mm longus, filiformis, sub stigmate paulum attenuatus; stigma stylo aequicrassum, obtusissimum. Cetera ignota.

This description is based on all the materials available. Warburg's specimen differs from the type specimen only in the corolla being 2 mm shorter.

*Amyema polillensis* is nearly related to *A. umbellata* from Boeroe (Moluccas), and differs from this species chiefly by glabrous inflorescences, less-flowered umbels, much shorter corollas and shorter filaments and anthers.[4]

POLILLO, *Bur. Sci. 10384 McGregor* (M), type, flower yellow. LUZON, Tayabas Province, Binangonan (coast opposite Polillo), *Warburg 13327* (Be).

**15. AMYEMA FASCICULATA (Blume) Danser.**

*Loranthus fasciculatus* BLUME, Bijdr. 13 (1825) 661.
*Scurrula fasciculata* G. DON., Gen. Hist. Dichl. Pl. 3 (1834) 421.
*Dendrophthoe fasciculata* MIQ., Fl. Ind. Bat. 1 1 (1856) 815.
*Loranthus mirabilis* VAN HUERCK and MUELL., Arg., Act. Soc. Helv. Sc. Nat. 55 (1872) 47 n. v.; MERR., Philip. Journ. Sci. 1 Suppl. (1906) 187 excl. specim.; § C 4 (1909) 135; Enum. Philip. Fl. Pl. 2 (1923) 107.
*Stemmatophyllum Cumingii* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 505, 546, 547.
*Loranthus Cumingianus* ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 128.
*Amyema fasciculata* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 295; 11 (1931) 330; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 27.
For a more extensive list of synonyms cfr. Bull. Jard. Bot. Buitenzorg III 11 (1934) 330.

Glabra, exceptis inflorescentiis floribusque valde juvenilibus dense breviterque postea tenuius puberulis. Ramuli ramosissimi dichotomi rarius tri- vel tetrachotomi, vel ex internodiis ramulos singulos laterales proferentes, internodiis juvenilibus teretibus nodis valde incrassatis folia, adulta ferentibus 2 ad 13 cm longis, 1 ad 4 mm crassis. Folia verticillata quaternata; petiolus supra basin paulum incrassatam teres, laminam versus supra applanatus, 2 ad 8 mm longus, 1 ad 3 mm crassus; lamina elliptica vel oblonga vel obovato-elliptica, 4 ad 15 cm longa, 2 ad 6 cm lata, basi acuta in petiolum attenuata, obtusissima vel apicem obtusum versus breve acuminata, utraque facie opaca, crassiuscula et fragilis, costa supra plana visibilis, subtus prominente, nervis ceteris indistinctis vel invisibilibus. Inflorescentiae umbellae simplices pedunculatae 4-florae, in nodis vetustioribus et tota longitudine internodiorum vetustiorum e lenticellis procrescentes; pedunculus teres, basi magis vel minus clavatus, apice in disculum dilatatus, 3 ad 5 mm longus, c. 0.4 mm crassus; pedicelli teretes, 1 ad 1.5 mm longi, 0.25 mm crassi; bracteae 2 ad apicem pedunculi minimae vel subnullae, ad basin floris ovatae semiamplexicaules, acutae vel obtusae, c. 0.5 mm longae. Calicis tubus campanulatus, 1.5 ad 2 mm longus, 1.5 mm latus; limbus brevissimus erectus integer, 0.25 ad 0.5 mm longus. Corolla statu alabastri adulti 16 ad 20 (28) mm longa, ima basi vel paulum supra basin rotundata, usque ad constrictionem c. 3 (4.5) mm ab apice paulum inflata 2.5 mm lata, ad constrictionem 1.5 mm lata, supra constrictionem prismatica vel conica, obtusa, postea dehiscens in petala 4 saepe bina cohaerentia. Filamenti pars libera 1 (2) mm longa. Anthera 2 ad 2.5 (3.5) mm longa, obtusa, loculis 4 continuis. Stylus rectus et fere tota longitudine aequicrassus, 18 ad 20 (31) mm longus, sub stigmate tantum paulum attenuatus; stigma stylo vix crassius, obtusum. Fructus obovato-ellipsoides, maximus 6 mm longus, 4 mm crassus.

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[4] Cfr. Bull. Jard. Bot. Buitenzorg III 11: 352.

The dimensions added between brackets are those of the specimen *Velasco 24118,* peculiar by extraordinarily long flowers.

Philippine Islands, without exact locality, *Cuming 1966* (M, NY, L, Be), cotypes of *Loranthus mirabilis* Van Huerck and Muell. Arg., and of *Stemmatophyllum Cumingii* Van Tiegh. LUZON, Cagayan Province, Ballesteros, 70 m altitude, *F. B. 24118 Velasco* (M), flower red; Malaguey, *Warburg 11705* (Be): Bataan Province, Mount Mariveles, *Copeland s. n.* (M): Rizal Province, Santa Ines, 100 m altitude, *Bur. Sci. 26212 Ramos*

(M, NY), flower yellow and green; Montalban, *Loher 6724* (Be) : Laguna Province, San Antonio, Dahican, *Bur. Sci. 15108 Ramos* (M, L), flower yellow.

Further distribution: Java.

**16. AMYEMA AQUILONIA Danser sp. nov.** Plate 2, figs. 2 to 5.

Omnis glabra. Ramuli ramosissimi, plerumque dichotomi, passim tri- vel tetrachotomi, internodiis teretibus ad nodos incrassatis, folia adulta ferentibus 2 ad 8 cm longis, 1.5 ad 2.5 mm crassis, nodis ad duplo crassioribus. Folia verticillata quaternata; petiolus supra basin paulum incrassatam teres, laminam versus supra applanatus 3 ad 5 mm longus, 0.75 ad 1.5 mm crassus; lamina elliptica vel oblonga, raro leviter obovata, 3.5 ad 6 cm longa, 1 ad 2.5 cm lata, basi acuta, apicem obtusiusculum versus acuta vel leviter acuminata, crasse coriacea, facie superiore semilucida inferiore opaca, costa supra vix visibili, subtus basin versus prominente, nervis ceteris vix visibilibus. Inflorescentiae umbellae simplices 4-florae, e nodis vetustioribus et e lenticellis internodiorum vetustiorum procrescentes; pedunculus teres, basi paulum clavatus, apice paulum disciformis, c. 2 mm longus, 0.4 mm crassus; pedicelli teretes, 0.5 ad 1 mm longi; bracteae ad apicem pedunculi vix visibiles, ad bases florum late ovatae, obtusae vel acutae, 0.5 ad 0.75 mm longae. Calicis tubus campanulato-obovatus, 1.5 ad 2 mm longus, 1.5 mm latus, limbus brevissimus, erectus, integer, vix 0.25 mm longus. Corolla statu alabastri adulti 14 ad 15 mm longa, inter basin rotundatam et constrictionem 2 mm ab apice leviter inflata ad 3 mm lata, supra constrictionem breve cylindrica c. 1.75 mm crassa apice rotundata, postea dehiscens in petala 4 linearia 1.75 mm lata usque ad 2 mm ab apice, parte superiore ovata obtusa. Anthera subsessilis, ovata, c. 2 mm longa, obtusa. Stylus c. 15 mm longus, sub stigmate paulum attenuatus; stigma paulo crassius quam styli apex, obtusum. Cetera ignota.

Closely related to *Amyema fasciculata,* differing by smaller, harder, more elliptic leaves, smaller and quite glabrous flowers and inflorescences.

LUZON, Ilocos Norte Province, Bangui, Mount Palimlim, 1,050 m altitude, near summit, *Bur. Sci. 33296 Ramos* (M, type, B, L, B, cotypes), flower blood red and green.

**16a. AMYEMA SESSILIFOLIA (Van Tieghem) Danser.**

*Stemmatophyllum sessilifolium* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 506, 546.

*Loranthus sessilifolius* ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 128.

*Amyema sessilifolia* DANS., Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 34.

Though the fragments of *Cuming 1956* in the Philippine National Herbarium indeed are an *Amyema* not distinguishable from *A. luzonensis*; I cannot agree with Merrill in placing *Stemmatophyllus sessilifolium* among the synonyms of the latter species. Van Tieghem describes the inflorescence as an "ombelle pauciflore axillaire, brièvement pédicellée," and consequently places his *St. sessilifolium* in one group with *St. Cumingii* (= *Amyema fasciculata*). Perhaps *Cuming 1956* may prove to be a mixture, like some other Cuming numbers, but the plant of which Van Tieghem describes the inflorescences is not *Amyema luzonensis*.

**17. AMYEMA NODOSA (Van Tieghem) Danser.**

*Stemmatophyllum nodosum* VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 506, 546.

*Loranthus nodosus* ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 128.

*Loranthus merrittii* MERR., Philip. Journ. Sci. § C 4 (1909) 134; Fl. Manila (1912) 184; Enum. Philip. Fl. Pl. 2 (1923) 107 excl. specim.

*Amyema nodosa* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 297; Verh. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 31.

Omnis glabra. Stolonibus plantae nutrici affixa. Ramuli ramosissime, plerumque dichotomi passim 3- vel 4-chotomi, internodiis teretibus nodis incrassatis, folia adulta ferentibus 1 ad 8 cm longis 1 ad 3.5 mm crassis, nodis ad duplo crassioribus. Folia verticillata plerumque quaternata raro opposita; petiolus basi teres, laminam versus supra applanatus, 3 ad 10 mm longus, 0.75 ad 1.5 mm crassus; lamina obovata vel anguste obovata, 3 ad 7 cm longa, 1 ad 3 cm lata, basi acuta vel in petiolum attenuata, apice rotundata, crasse coriacea et dura, utrinque opaca, costa supra plana indistincta, subtus basin versus prominente, nervis ceteris invisibilibus vel crassioribus indistinctis. Inflorescentiae paucae vel multae in nodis defoliatis, initio in axillis tantum, postea toto circuitu nodorum, in scrobiculis corticis insertae, umbellae simplices sessiles vel subssessiles 1 ad 2 florae raro 3-florae; pedicelli teretes, 0.5 ad 3 mm longi, 0.25 ad 0.75 mm crassi; bracteae rotundato-ovatae semiamplexicaules, plerumque obtusae, 0.5 ad 0.75 mm longae. Calicis tubus obovatus vel piriformis, 1.5

ad 2 mm longus, 1.25 ad 1.75 mm latus; limbus erectus vel infundibuliformis, 0.25 ad 0.5 mm longus, integer vel subinteger. Corolla statu alabastri adulti 8 ad 13 mm longa, supra basin rotundatam usque ad apicem rotundatum cylindrica paulum inflata 2 ad 3 mm lata, postea dehiscens in petala 5 ad 6 linearia. Anthera sessilis, c. 2 mm longa, obtusa, loculis 4 continuis. Stylus 2 ad 14 mm longus, tota longitudine subaequicrassus, dimidia parte superiore paululum crassior; stigma stylo nonnihil crassius, obtussissimum. Fructus obovatus vel paulum piriformis, ad 7 mm longus, 5 mm crassus, calicis limbo permanente coronatus.

The area of distribution of *Amyema nodosa* is remarkably continuous; central Luzon, Lubang, Mindoro, Sibuyan; it occurs "at low altitudes" (Merrill, Enum.). The flower color is indicated on the herbarium labels as red or orange with green tips.

Philippine Islands, without exact locality, *Cuming 1958* (M); *Cuming 1952* (M, Be), cotypes of *Stemmatophyllum nodosum* Van Tieghem. LUZON, Pangasinan Province, Alaminos, 40 m altitude, *F. B. 8348 Curran and Merritt* (M), *Bur. Sci. 41463 McGregor* (M, B, L, S, Be): Bataan Province, near Bagac, *F. B. 5977 Curran* (M): Bulacan Province, Malolos, *Bur. Sci. 19260 Aldaba* (M): Rizal Province, *Loher s. n.* (UC): Manila, *Merrill 3494* (M); Manglas de Maypajo, *Loher 4463* (M, Be): Laguna Province, along Puting Lupa, Mount Makiling, 100 to 200 m altitude, *F. B. 26366 Mabesa* (M): Tayabas Province, Kabibihan, *F. B. 28365 Mabesa* (M). LUBANG, sea level, *Merrill 960* (M, NY, S, Be). MINDORO, Cauayan, beach swamp, *F. B. 9893 Merritt* (M). SIBUYAN, Capiz, Mount Giting-giting, Magallanes, *Elmer 12412* (M, NY, B, L, U).

### 18. AMYEMA HUTCHINSONII (Merrill) Danser.

*Loranthus hutchinsonii* MERR., Philip. Journ. Sci. § C 4 (1909) 138; Enum. Philip. Fl. Pl. 2 (1923) 105.

*Amyema Hutchinsonii* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 296; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 30.

Omnis glabra. Stolonibus planta nutrici affixa. Ramuli teretes nodis incrassatis, plerumque dichotomi, internodiis folia adulta ferentibus 1 ad 8 cm longis, 2.5 ad 6 mm crassis, nodis susquiplo vel duplo crassioribus. Folia plerumque opposita, rarius sparsa vel ad 4 in verticillos approximata; petiolus teres, prope laminam supra applanatus, basin incrassatus, 5 ad 10 mm longus, 1 ad 2 mm crassus; lamina obovata vel rotundato-elliptica, 4 ad 8 cm longa, 3 ad 5.5 cm lata, basi late vel anguste cuneata, vel paulum in petiolum attenuata, apice late rotundata vel obtusissima, utrinque opaca, crasse coriacea, costa facie inferiore basin versus prominente, apicem versus et facie superiore indistincta, nervis ceteris invisibilibus vel crassioribus indistinctis. Inflorescentiae umbellae sessiles floribus 1 vel 2 raro e, in axillis foliorum positae vel toto circuitu nodorum vetustiorum, in scrobiculis corticis insertae; pedicelli teretes, 0.5 ad 3 mm longi, 0.3 ad 0.4 mm crassi; bracteae rotundato-ovatae, semiamplexicaules, obtusae, 1 ad 5 mm longae. Calicis tubus infundibuliformi-obovatus vel magis campanulatus, c. 2.5 mm longus, 1.5 ad 2 mm latus, limbus c. 0.75 mm longus, infundibuliformis integer. Corolla statu alabastri adulti subcylindrica, basi apiceque rotundata, 18 ad 22 mm longa, postea partita in petal 5 linearia c. 1 mm lata in 3 quartas longitudinis paulum dilatata ibi 1.25 ad 1.5 mm lata, parte superiore 3.5 mm longa reflexa subspathulata, apice incurvata obtusa. Filamenti pars libera 0.5 ad 1 mm longa; anthera 2.5 mm longa, obtusa, loculis 4 continuis. Stylus 18 ad 22 mm longus, apicem versus sensim paululum incrassata; stigma style apice sesquiplo crassius, obtusum vel obtusissimum. Fructus rotundato-ellipsoides, ad 8 mm longus, 5 ad 6 mm crassus, calicis limbo permanente coronatus.

MINDANAO, Misamis Province, Mount Malindang, 1,100 m altitude, *F. B. 4554 Mearns and Hutchinson* (M, NY, B, Be, L), flowers red, type of *Loranthus hutchinsonii* Merr. PALAWAN, Silanga, 400 m altitude, *Merrill 9586* (M), flowers yellowish.

### 19. AMYEMA WENZELII (Merrill) Danser.

*Loranthus Wenzelii* MERR., Philip. Journ. Sci. § C 8 (1913) 370; Enum. Philip. Fl. Pl. 2 (1923) 111.

*Amyema Wenzelii* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 299; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 35.

Omnis glabra. Stolonibus plantae nutrici affixa. Ramuli teretes nodis incrassatis, parce ramosi, internodiis folia adulta ferentibus 7 ad 14 cm longis, 3 ad 6 mm crassis nodis ad duplo crassioribus. Folia opposita vel 4 verticillata, magna; petiolus supra basin paulum incrassatam teres, laminam versus supra applanatus vel leviter canaliculatus, 10 ad 20 mm longus, 2.5 ad 5 mm crassus; lamina ovata vel oblonga, 11 ad 27 cm longa, 5 ad 15 cm lata, basi cuneata vel rotundata, apicem obtusissimum versus saepe paulum acuminata, crasse coriacea, utrinque opaca, costa supra paulum convexa distincta, subtus valde prominente, nervis lateralibus crassioribus utrinque visibilibus, tenuioribus plerumque invisibilibus. Inflorescentiae numerosae in stolonibus et in nodis ramorum vertustiorum, umbellae sessiles floribus 1 vel 2, raro 3, in scrobiculis corticis insertae; pedicelli 0 ad 2 mm longi, teretes, 0.25 ad 0.5 mm crassi; bracteae suborbiculares obtusae ad ovatae acutae, c. 1 mm longae. Calicis tubus infundibuliformi-obovatus, 1.5 ad 2 mm longus, c. 1.25 mm latus; limbus plerumque erectus, integer vel levissime dentatus, c. 0.75 mm longus. Corolla statu alabastri adulti 12 ad 14 mm longa, a basi rotundata usque ad 2 ad 2.5 mm ab apice late cylindrica paulum inflata ad 2 mm lata, parte superiore 2 ad 2.5 mm longa cylindrica 1 mm lata obtusissima, postea partita in petala 5 linearia, versus insertionem filamentorum paulum dilatata, parte superiore angustiora, reflexa, apice incurvata obtusa. Anthera sessilis, c. 2.5 mm longa, obtusa, loculis 4 continuis. Stylus a basi ad apicem paululum incrassatus, 14 ad 16 mm longus; stigma stylo paulo crassius, obtusissimum. Cetera ignota.

LEYTE, Dagami, Panda, 60 m altitude, *Wenzel 24* (M), flower yellow, type of *Loranthus Wenzelii* Merr.; Tacloban, *Wenzel 1739* (M), flower green and yellow. BOHOL, Bilar, 600 m altitude, *Bur. Sci. 43282 Ramos* (M, UC, B, S, Be) and *43339 Ramos* (M, UC), flower yellow, tips green.

Probably also: MINDANAO, Lanao Province, Lake Lanao, Camp Keithley, *Clemens s. n.* (M).

### VIII. Genus DICYMANTHES Danser

*Dicymanthes* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 292, 311, 365, 366; 11 (1931) 236, 263; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 5, 49.

Inflorescentia capitata, floribus plerumque 6 omnibus sessilibus in triadibus 2 dispositis, raro paucioribus, involucro e bracteis 2 bracteolisque 4 verticillum singulum formantibus composito. Corolla 5- vel 6-meres, choripetala. Antherae basifixae, loculis 4 continuis.

The genus *Dicymanthes* is spread in the Philippines from central Luzon to southern Mindanao and the Sulu Islands, but not from Mindanao and Panay to Palawan. Outside the Philippines it extends only in a southern direction over Celebes and the Moluccas to eastern Java and the Lesser Sunda Islands.

The eight species formerly described I have reduced to six, and to these I have added one new species. Moreover, it must

be remarked, that the species first described, *Dicymanthes cauliflora,* is the only one with an aberrant inflorescence, composed of only three flowers and with an involucre of only three bracts. I suppose it is a reduced form of *D. seriata,* with which it agrees in other characters.

### *Key to the Philippine species of Dicymanthes.*

1. Leaves attenuate at the base and distinctly petioled.................................... 2.
   Leaves attenuate at the base to slightly cordate, but not or hardly petioled ........................................................................................ 4.
2. Petals without scale at the inside above the base; inflorescences on the nodes, not along the internodes; peduncle of the inflorescence 3 to 7 mm long ..................................................................... 1. *D. hexantha.*
   Petals with a scale at the inside above the base; inflorescences along the internodes and on the creepers, rarely on the nodes; peduncle of the inflorescence 1 to 2 mm long.......................................................... 3.
3. Heads 6-flowered ............................................................. 2. *D. seriata.*
   Heads 3-flowered ........................................................ 3. *D. cauliflora.*
4. Inflorescences entirely sessile, even somewhat sunken in the bark. 7. *D. cuernosensis.*
   Inflorescences more or less peduncled.................................................. 5.
5. Anther nearly 1.5 mm long; clavate apical part of the corolla bud not longer than 2.5 mm; peduncle of the inflorescence usually 4 to 6 mm long ...................................................................................... 4. *D. Edanoii.*
   Anther 2.5 to 4 mm long; clavate part of the corolla bud 4 to 7 mm long; peduncle of the inflorescence usually 1 to 3 mm long................. 6.
6. Leaves and twigs thick and coarse.................................... 5. *D. samarensis.*
   Twigs slender, leaves rather thin........................................... 6. *D. suluana.*

#### 1. **DICYMANTHES HEXANTHA (Merrill) Danser.**

*Loranthus hexanthus* MERR., Philip. Journ. Sci. § C 4 (1909) 137; ELMER, Leafl. Philip. Bot. 3 (1911) 1073; MERR., Enum. Philip. Fl. Pl. 2 (1923) 105.

*Dicymanthes hexantha* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 311; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 49.

Omnis glabra. Ramuli ramosissimi, dichotomi vel tri- vel tetrachotomi, nodis incrassatis, internodiis folia adulta ferentibus 3 ad 11 cm longis, 1.5 ad 3 mm crassis, nodis ad duplo crassioribus. Folia opposita vel rarissime verticillata quaternata; petiolus saepe difficile a lamina distinguendus, subtus rotundatus, supra prope basin leviter versus laminam magis applanatus, 5 ad 10 mm longus, 1 ad 1.5 mm latus; lamina plerumque ovata, 6 ad 18 cm longa, 3 ad 9 cm lata, basi cuneata vel magis in petiolum contracta, apicem obtusum versus sensim attenuata vel magis

acuminata, crassiuscula, utrinque opacissima, facie superiore costa nervisque crassioribus indistinctis venis invisibilibus, inferiore costa basin versus valde prominente nervis lateralibus plerumque invisibilibus. Capitula floribus 6 bracteisque 6, singula in axillis foliorum adultorum et gregatim ad nodos vetustiores; pedunculus teres, 3 ad 1 mm longus, 1 ad 1.5 mm crassus; bracteae florum mediorum rotundato-ovatae, c. 2 mm longae, reflexae, bracteolae florum lateralium nonnihil angustiores, adpressae. Calicis tubus campanulatus 2 ad 2.5 mm longus, apice c. 1.5 mm latus; limbus infundibuliformis, 1.5 mm longus, crenatus vel leviter irregulariterque lobatus. Corolla statu alabastri adulti c. 17 mm longa, supra basin rotundatam 2 mm latam ad 0.6 longitudinis sensim ad 1 mm attenuata, parte tertia superiore ellipsoides 1.5 ad 2 mm crassa, acute quinquangula, obtusiuscula, postea partita in petala 5 paulum supra basin c. 0.75 mm lata, medium versus attenuata ad dimidiam latitudinem, parte superiore 6 mm longa anguste lanceolata, crassiuscula, acutiuscula, c. 0.75 mm lata, primum in parte superiore tantum postea magis recurvata (facie interiore supra basin squama nulla). Filamenti pars libera c. 2 mm longa; anthera 2 ad 2.5 mm longa, acutiuscula. Stylus corolla subaequilongus, stigma versus paulum attenuatus; stigma styli parte inferiore aequicrassum subglobosum, obtusissimum. Fructus ellipsoides, ad 6 mm longus, 4 mm crassus, calicis limbo permanente acuto ad 2 mm longo erecto vel subinfundibuliformi coronatus.

MINDANAO, Lanao Province, Lake Lanao, south side, Vicar's landing, *Clemens s. n.* (M), type of *Loranthus hexanthus* Merr.: Bukidnon Province, Tangulan, *Bur. Sci. 39038 Ramos and Edaño* (L, Be): Davao Province, Mount Apo, Todaya, *Williams 2565* (M, NY), flowers red; *Elmer 10462* (M, NY, B, L) and *11813* (NY, B. L); Mount Apo, Sibulan, *Clemens s. n.* (UY), flowers red, *Warburg 14766* (Be).

**2. DICYMANTHES SERIATA (Merrill) Danser.**

*Loranthus seriatus* MERR., Philip. Journ. Sci. § C 9 (1914) 285; Enum. Philip. Fl. Pl. 2 (1923) 109.

*Dicymanthes seriata* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 311; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 49.

Omnis glabra. Ramuli teretes, nodis incrassatis, pluries dichotomi, internodiis folia adulta ferentibus 6 ad 20 cm longis, 2.5 ad 5 mm crassis, nodis ad duplo crassioribus. Folia opposita;

petiolus semper distinctus, saepe difficile a lamina distinguendus, 5 ad 8 mm longus, 1.5 ad 2 mm latus, subtus rotundatus, supra prope basin leviter, laminam versus magis applanatus; lamina ovata vel oblongo-ovata, 8 ad 16 cm longa, 4.5 ad 7.5 lata, basi cuneata vel rotundata, supera in petiolum contracta, apicem obtusiusculum versus magis vel minus acuminata, crassiuscula, utrinque opaca, penninervis, nervis lateralibus obliquis vel magis incurvatis, costa nervisque lateralibus crassioribus utrinque distinctis, costa subtus magis prominente. Capitula floribus 6 bracteisque 6, unilateraliter in tota longitudine internodiorum et in toto circuitu nodorum defoliatorum e lenticellis procrescentia; pedunculus subteres, c. 2 mm longus, 1 mm crassus; bracteae patentes suborbiculares bracteolaeque magis ovatae adpressae c. 1.5 mm longae, apice rotundatae. Calicis tubus campanulato-obovatus, c. 2 mm longus, 1.5 mm latus; limbus c. 0.5 mm longus infundibuliformis, subinteger. Corolla statu alabastri adulti c. 20 mm longa, a basi rotundata c. 2.5 mm lata medium versus in dimidiam latitudinem attenuata vel nonnihil inflata, in tertia parte apicali in clavan obtusam quinquangulam c. 2 mm crassam inflata, postea partita in petala 5 recurvata, latere interiore ad 2 ad 3 mm supra basin squamula deflexa c. 0.5 mm longa, parte inferiore c. 0.6 mm lata, deinde sensim attenuata sed parte superiore 6 mm longa spathulata crassiuscula subacutae. Filamenti pars libera 0 ad 1 mm longa; anthera 3 ad 4 mm longa, acutiuscula. Stylus tota longitudine subaequicrassus, prope stigma palum attenuatus; stigma styli parte basali aequicrassum, subglobosus, obtusissimum. Cetera ignota.

MINDANAO, Zamboanga Province, Mount Pulongbato, *Bur. Sci. 16424 Reillo* (M, Be), type of *Loranthus seriatus* Merr.: Bukidnon Province, Mount Tangulan, Poquitnan, *Bur. Sci. 21380 Escritor* (M, NY, B, L).

### 3. DICYMANTHES CAULIFLORA (Merrill) Danser.

*Loranthus cauliflorus* MERR., Philip. Journ. Sci. 1 Suppl. (1906) 185; § C 4 (1909) 136; ELM., Leafl. Philip. Bot. 6 (1913) 1960; MERR., Enum. Philip. Fl. Pl. 2 (1923) 103.

*Dicymanthes cauliflora* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 311; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 49.

Omnis glabra. Stolonibus plantae nutrici affixa. Ramuli teretes, nodis incrassatis, internodiis folia adulta ferentibus 4 ad 22 cm longis, 3 ad 5 mm crassis, nodis ad duplo crassioribus.

Folia opposita; petiolus semper distinctus saepe difficile a lamina distinguendus, ad 25 mm longus, ad 5 mm latus, subtus rotundatus, supra prope basin leviter, laminam versus magis applanatus; lamina oblongo-ovata vel lanceolato-ovata, ad 21 cm longa, 8 cm lata, basi cuneata vel in petiolum contracta, apicem obtusiusculum versus sensim attenuata vel leviter acuminata, crassiuscula, utrinque opacissima, penninervis, nervis lateralibus valde incurvatis, facie superiore costa et nervis crassioribus leviter convexis sed distinctis, venis invisibilibus, facie inferiore costa basin versus valde prominente apicem versus indistincta, nervis lateralibus crassioribus visibilibus. Capitula floribus 3 bracteisque 3, numerosa, in internodiis et stolonibus e lenticellis praecipue unilateriter procrescentia; pedunculus subteres, 1 ad 2 mm longus subaequicrassus; bracteae rotundato-ovatae obtusissimae, 1 ad 1.5 mm longae. Calicis tubus campanulato-obovatus, 1.5 ad 2 mm longus, 1.25 ad 1.5 mm latus, limbus c. 0.5 mm longus, crenatus vel leviter lobatus. Corolla statu alabastri adulti 15 ad 22 mm longa, supra basin rotundatam 2.5 mm latam sensim attenuata, ad duas tertias longitudinis 0.5 ad 0.75 mm lata, deinde in clavam anguste ellipsoidem c. 1 mm crassam dilatata, apicem obtusiusculum vel obtusum versus sensim attenuata, tota longitudine angulata, postea devisa in petala 5 raro 6 supra basin dilatata, deinde sensim attenuata usque ad duas tertias longitudinis, parte tertia superiore lanceolata acutiuscula vel obtusa, facie interiore 2 ad 3 mm supra basin squamula obtusa 1 ad 2 mm longa deflexa. Anthera sessilis vel subsessilis, linearis, obtusa, 4 ad 6 mm longa. Stylus corolla subaequilongus vel paulo longior, parte tertia superiore paulo tenuior quam parte inferiore; stigma parte styli inferiore aequicrassum, obtusissimum. Fructus maturus ignotus.

MINDANAO, Lanao Province, Lake Lanao, west of Camp Keithley, *Clemens 55* (M), type of *Loranthus cauliflorus* Merr., flowers bright red; also *Clemens s. n.* (M).

4. **DICYMANTHES EDANOII (Merrill) Danser.**

*Loranthus Edanoii* MERR., Philip. Journ. Sci. § C 13 (1918) 275; Enum. Philip. Fl. Pl. 2 (1923) 104.

*Dicymanthes Edanoii* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 311; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 49.

Glabra, inflorescentiis juvenilibus breve puberulis exceptis. Ramuli dichotomi, internodiis teretibus nodis incrassatis, folia adulta ferentibus 8 ad 11 cm longis, 1.5 ad 4 mm crassis, nodis sesquiplo vel duplo crassioribus. Folia opposita sessilia vel subsessilia; lamina ovato-oblonga, 10 ad 17 cm longa, 4 ad 6 cm lata, basi plerumque rotundata rarius cuneata vel leviter cordata, apicem obtusiusculum vel obtusum versus acuta vel acuminata, crassiuscula, utrinque opaca, penninervis, costa nervisque lateralibus crassioribus utrinque leviter prominentibus, distinctis, costa basin versus facie inferiore valde prominente. Capitula floribus 6 bracteisque 6, singula in axillis foliorum vel plura ex nodis vetustioribus, vel etiam secus internodia e tuberculis (lenticellis?) procrescentia; pedunculus leprosulus, teres vel paulum applanatus, 4 ad 6 mm longus, basi c. 1.5 mm crassus, sub apice paulum incrassatus c. 1 mm crassus; bracteae paulum reflexae bracteolaeque erectae 1 ad 1.25 mm longae, orbiculares, vel bracteolae paulum ovatae. Calicis tubus campanulato-infudibuliformis, 2 ad 2.5 mm longus, 1.5 mm latus, leprosulus ut pedunculus limbus plerumque erectus, integer vel subinteger, c. 0.5 ad 1 mm longus. Corolla statu alabastri adulti c. 11 ad 13 (raro ad 17) mm longa, a basi c. 1.5 mm lata sensim attenuata,.sub clavam terminalem c. 0.75 mm lata, clava terminali globosa vel obovata, acute angulata, c. 1.5 ad 2 mm crassa, 2 ad 2.5 mm longa, postea partita in petala 5 recurvata, a basi usque ad 2.5 mm ad apice sensim attenuata, parte apicali spathulata crassiuscula, facie interiore c. 1.5 mm supra basin squamula deflexa c. 0.75 mm longa. Filamenti pars libera 0.5 (raro ad 1.5) mm longa; anthera 1 ad 1.5 (raro ad 2) mm longa. Stylus corolla aequilonga, sub apice paulum attenuata; stigma paulo crassius, obtusissimum. Fructus ellipsoides vel obovoides, ad 8 mm longus, 5 mm crassus, limbo calicis 1 mm longo integro coronatus; semen obovatum, c. 3.5 mm longum, 2 mm crassum.

*Dicymanthes Edanoii* has a peculiar and remarkably continuous distribution, from central Luzon to Leyte, but in neither northern Luzon nor the southern and southwestern Philippines. It has been collected from sea level to an altitude of 600 m. The flowers are red.

LUZON, Nueva Ecija Province, Mount Umingan, 40 m altitude, *Bur. Sci. 26241 Ramos and Edaño* (M, type, NY, cotype of *Loranthus Edanoii* Merr.) : Rizal Province, San Andales, Mayali River, low altitude, *Bur. Sci. 48743 Edaño* (M, NY, UC, B) : Laguna Province, Sitio Tubog, Paete, 400 m altitude, *F. B. 29743 Sulit* (M, NY, UC) ; Cavinti, 300 m altitude, *F. B. 9569 Curran*

(M); San Antonio, Pamasak, *Bur. Sci. 10965 Ramos* (M); Dahican River, *Ramos 1136* (N, U, Br): Tayabas Province, Infanta, near Agos River, 5 m altitude, *Bur. Sci. 9337 C. B. Robinson* (M); Mount Binuang, San Mateo River, 35 mm altitude, *Bur. Sci. 28800 Ramos and Edaño* (M); Umiray, *Bur. Sci. 28998 Ramos and Edaño* (M, UC): Camarines Sur Province, Mount Cauayan, *Bur. Sci. 22179 Ramos* (M): Albay Province, Mount Mayon, 600 m altitude, *Bur. Sci. 6482 C. B. Robinson* (M). CATANDUANES, San Jose, low altitude, *Bur. Sci 75404 Ramos and Edaño* (M, NY, UC, B, S). SAMAR, Loquilocon, 250 m altitude, *Bur. Sci. 43698 McGregor* (M, NY, UC, B). BILIRAN, *Bur. Sci. 18918 McGregor* (M). LEYTE, Bango, *F. B. 11571 Whitford* (M); Jaro, Boista, 500 m altitude, *Wenzel 560* (M); Mount Abucayan, low altitude, *Bur. Sci. 41657 Edaño* (M, S, B, L, Be).

### 5. DICYMANTHES SAMARENSIS (Merrill) Danser.

*Loranthus samarensis* MERR., Philip. Journ. Sci. § C 13 (1918) 276; Enum. Philip. Fl. Pl. 2 (1923) 109 excl. specim.

*Dicymanthes samarensis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 311; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 49.

Omnis glabra. Ramuli robusti dichotomi, nodis incrassatis, internodiis folia adulta ferentibus 11 ad 13 cm longis, 4 ad 7 mm crassis. Folia opposita sessilia; lamina ovata, 14 ad 17 cm longa, 6 ad 11 cm lata, basi rotundata vel leviter cordata, apicem obtusiusculum versus paulum acuminata, crassa, utraque facie opaca etiam granulis minimis scabra, costa basin versus valde prominente, nervis lateralibus crassioribus minus prominentibus sed distinctis, venis crassioribus visibilibus. Capitula floribus 6 bracteisque 6, secus internodia defoliata e tuberculis (lenticellis?) procrescentia; pedunculus 2 ad 3 mm longus, basi c. 2 mm apice c. 1.5 mm crassus; bracteae reflexa, bracteolae adpressae, omnes suborbiculares c. 1 mm longae. Calicis tubus campanulatus, 2.5 ad 3 mm longus, apice 1.5 ad 2.5 mm latus; limbus 0.5 ad 0.75 mm longus, infundibuliformis, subinteger. Corolla statu alabastri adulti 17 ad 19 mm longa, supra basin ad 3 mm inflata, dein sensim attenuata, in 4 mm superioribus in clavam ellipsoidem obtusissimam 5-angulam incrassata, postea partita in petala recurvata e basi c. 1.25 mm lata ad 0.75 mm angustata, parte apicali lanceolata c. 1 mm lata acutiuscula crassiuscula, facie interiore c. 2 mm supra basin squamula deflexa obtusa c. 1 mm longa. Filamenti pars libera c. 1.5 mm longa;

anthera 2.5 ad 3 mm longa, oblonga, subacuta. Fructus ellipsoides, immaturus tantum notus, calicis limbo integro erecto coronatus.

The only material I can refer to this species is the type in the Philippine National Herbarium. The other specimens, mentioned by Merrill in his Enumeration, are *D. cuernosensis.* Most closely related is *D. suluana,* but as the appearance of this is very different, and the materials of *D. samarensis* are insufficient to get a clear idea of this species, I could not unite these two.

SAMAR, Catubig River, 12 m altitude, *Bur. Sci. 24265 Ramos* **(M)**, flower red.

### 6. DICYMANTHES SULUANA Danser sp. nov. Plate 2, figs. 6 to 10.

Glabra, inflorescentiis calicibusque valde juvenilibus brevissime puberulis mox glabrescentibus exceptis. Ramuli subrobusti, graciles, pluries dichotomi, passim tri- vel tetrachotomi, teretes, nodis incrassatis, internodiis 5 ad 15 cm longis, folia adulta ferentibus 1.5 ad 3.5 cm crassis, nodis primum paulum dilatatis, postea ad duplo crassioribus. Folia opposita sessilia vel brevissime petiolata; petiolus, si adest, difficile a lamina distinguendus, maxime 7 mm, plerumque 0 ad 2 longus, supra leviter convexus, subtus rotundatus; lamina ovata rarius ovato-oblonga, 6 ad 22 cm longa, 3 ad 10 cm lata, basi in petiolum contracta rarius cuneata, apicem obtusiusculum versus magis vel minus acuminata, praecipue in foliis majoribus, crassiuscula, fragilis, utraque facie opaca, penninervis nervis lateralibus incurvatis, facie superiore costa, nervis lateralibus et venis crassioribus, leviter prominentibus distinctis, inferiore costa prominente nervis lateralibus visibilibus. Capitula floribus 6 bracteisque 6, singula in axillis foliorum juniorum, vel plura in axillis foliorum vetustiorum vel etiam e lenticellis internodiorum defoliatorum; pedunculus teres, c. 1.5 mm longus et crassus; bracteae palum reflexae et bracteolae adpresae suborbiculares c. 1.75 mm longae. Calicis tubus campanulatus, 0.2 mm longus, apice 1.25 ad 1.5 mm latus, limbus erectus vel infundibuliformis, c. 0.75 mm longus, integer vel subinteger. Corolla statu alabastri adulti 18 ad 24 mm longa, a basi rotundata c. 2.5 mm lata in dimidia parte inferiore sensim ad c. 1.75 ad 1 mm attenuata, usque ad 7 mm ab apice aequilata 5-angula, supra in clavam 5-angulam obtusam 1.75 ad 2 mm crassam inflata, postea dehiscens in petala 5 recurvata, in parte inferiore c. 1 mm lata deinde attenuata, parte tertia media vix 0.5 mm lata parte superiore 6 ad 7 mm longa lanceolata, apice crassiuscula obtusiuscula c. 0.75 mm lata, facie interiore 2 ad 3 mm supra basin squamula obtusa deflexa c. 1 mm longa. Filamenti pars libera 0 ad 1 mm longa; anthera 3 ad 4 mm longa, obtusa vel obtusiuscula. Fructus ellipsoides, calicis limbo permanente infundibuliformi coronatus.

*Dicymanthes suluana* is closely related to *D. samarensis*, but whereas the appearance of the various specimens of *D. suluana* is very similar, they are strikingly different from the type of *D. samarensis*. The latter species, however, is still insufficiently known. There are notable differences, especially in the leaves; in *D. suluana* these are smaller, thinner, more grayish, and of finer texture, usually attenuate at the base or even petioled. These differences are in general too small to distinguish species, but if I had not accepted them provisionally as such, I would have been obliged to unite also *D. suluana* and *D. samarensis* with *D. Edanoii.*

Among the Dutch East Indian species, *D. longipes* is nearly related.

LUZON, Sorsogon Province, Mount Bulusan, Irosin, *Elmer 15292* and *14984* (M, UC, B, L, U). JOLO (= Sulu), *Warburg 14842* (Be); Mutu and Gandasuri, from sea level to 20 m altitude, *Link 25* (M), flower deep red; Mount Daho, 600 m altitude, *Bur. Sci. 43894 Ramos and Edaño* (M, type, UC, NY, B, cotypes), flower red.

### 7. DICYMANTHES CUERNOSENSIS (Elmer) Danser.

*Loranthus cuernosensis* ELMER, Leafl. Philip. Bot. 2 (1908) 469; MERR., Philip. Journ. Sci. § C 4 (1909) 138; Enum. Philip. Fl. Pl. 2 (1923) 103 excl. specim.

*Loranthus apoensis* ELMER, Leafl. Philip. Bot. 3 (1911) 1073; MERR., Enum. Philip. Fl. Pl. 2 (1923) 102.

*Loranthus falcatifolius* MERR., Philip. Journ. Sci. § C 9 (1914) 286; Enum. Philip. Fl. Pl. 2 (1923) 104.

*Dicymanthes cuernosensis, apoensis, falcatifolia* DANSER, Bull. Jard. Bot. Buitenzorg III 10 (1929) 311.

Omnis glabra. Stolonibus plantae nutrici affixa. Ramuli teretes, nodis incrassatis, internodiis folia adulta ferentibus 1 ad 1.4 cm longis, 2 ad 5 mm crassis, junioribus apicem versus applanatis et dilatatis, vetustioribus ad nodos magis incrassatis, duplo vel triplo crassioribus quam media parte. Folia opposita sessilia; lamina ovata ad ovato-lanceolata vel rarius magis elliptica vel oblonga, 6 ad 20 cm longa, 3 ad 7.5 cm lata, basi cuneata vel rotundata vel leviter cordata, apicem obtusiusculum versus acuta vel magis acuminata, crassiuscula, utrinque opaca, penninervis, nervis lateralibus obliquis numerosis, facie superiore costa visibili basin versus paulum prominente, nervis lateralibus crassioribus etiam paulum prominentibus visibilibus, facie inferiore costa basin versus valde prominente, apicem versus indistincta, nervis ceteris plerumque indistinctis. Capitula sessilia vel etiam in corticem immersa, floribus 4 ad 6, bracteis 6 (vel paucioribus 7), pauca in nodis junioribus in axillis et prope eas, numerosiora in toto circuitu nodorum defoliatorum, etiam gregatim in stolonibus ex scrobiculis corticis procrescentia; bracteae suborbiculares vel ovatae, obtusissimae, c. 2 mm longae. Calicis tubus subcylindricus, 1.5 ad 2.5 mm longus, 1 mm latus; limbus erectus vel cupulatus, c. 1.5 mm longus, leviter dentatus vel subinteger. Corolla statu alabastri adulti 20 ad 23 mm longa, gracilis, supra basin ad 2 mm inflata deinde sensim attenuata, tertia parte media tenuis, apicem versus in clavam ellipsoidem 1.25 ad 1.5 mm crassam 5-angulam acutam incrassata, postea dehiscens in petala 5 parte inferiore 1 mm lata deinde sensim attenuata, tertia parte media angustissima, parte superiore 6 ad 7 mm longa reflexa lanceolata c. 0.5 mm lata, acutiuscula, facie interiore c. 1.5 ad 2 mm supra basin squamula c. 0.5 mm longa obtusa deflexa. Filamenti pars libera plerumque 3 ad 4 mm longa, anthera linearis, 2.5 ad 4 mm longa. Stylus corolla subaequilongus, parte superiore attenuatus; stigma styli parte inferiore subaequicrassum, subglobosum, obtusissimum. Fructus nondum adultus ellipsoides, calicis limbo permanente erecto coronatus, maximus 6 mm longus, 4 mm crassus.

Though all species of *Dicymanthes* are very similar, the forms described as *Loranthus cuernosensis, L. apoensis,* and *L. falcatifolius* could not be kept apart as different species. The species we get in this way is spread over Negros and Mindanao and has been collected at different altitudes, between 900 and 1,800 m above sea level. The corolla is indicated as red, yellowish red, or brownish red, with a yellow or orange tip.

NEGROS, Canlaon Volcano, 1,350 m altitude, *Merrill 6996* (M); Cuernos Mountains, Dumaguete, *Elmer 9525* (M, NY, B, L, U, cotypes of *Loranthus cuernosensis*). MINDANAO, Bukidnon Province, Sumilao, *Bur. Sci. 15764* (M); *Bur. Sci. 15746 Fénix* (M), type of *Loranthus falcatifolius* Merr.; Tangculan and vicinity, Agusan River, 900 m, *Bur. Sci. 39159 Ramos and Edaño* (M);

Cumaycay River, 900 m altitude, *Bur. Sci. 39188 Ramos and Edaño* (M, B, L, Be): Davao Province, Mount Apo, Todaya, *Elmer 11454* (M, NY, B, L, U, cotypes of *Loranthus apoensis* Elmer); Mount Dagat-Bau (?), 1,200 to 1,800 m altitude, *Warburg 14768* (Be).

### IX. Genus HELIXANTHERA Loureiro

*Helixanthera* Lour., Fl. Conchinchin. 1 (1790) 142; Dans., Bull. Jard. Bot. Buitenzorg III 10 (1929) 292, 316, 357, 358, 366; 11 (1931) 236, 368; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 5, 55.

*Helicia* Pers., Synopsis 1 (1805) 214.

*Helicanthera* Spreng., Syst. 1 (1825) 755.

*Phoenicanthemum* Blume, in Schult., Syst. 7 2 (1830) 1729; Miq., Fl. Ind. Bat. 1 1 (1856) 823; Suppl. Sum. (1860) 138, 345; Van Tiegh., Bull. Soc. Bot. Fr. 41 (1894) 498, 502, 510, 544, 550; 42 (1895) 488.

*Strepsimella* Rafin., Sylva Tell. (1838) 159.

*Lanthorus* Presl., Epim. Bot. (1849) 256; Walpers, Ann. 2 (1852) 279; Van Tiegh., Bull. Soc. Bot. Fr. 41 (1894) 483, 487, 510, 543, 550.

*Chiridium, Sycophila, Leucobotrys* Van Tiegh., Bull. Soc. Bot. Fr. 41 (1894) 482, 483, 485, 497, 498, 503, 510, 540, 545, 550.

*Coleobotrys* Van Tiegh., Bull. Soc. Bot. Fr. 41 (1894) 482, 484, 510, 542, 550; Dans., Bull. Jard. Bot. Buitenzorg III 10 (1929) 292, 305, 367.

*Acrostachys* Van Tiegh., Bull. Soc. Bot. Fr. 41 (1894) 498, 504, 510, 543, 550; 42 (1895) 271.

*Dithecina* Van Tiegh., Bull. Soc. Bot. Fr. 42 (1895) 489.

Inflorescentia recemosa vel spicata, floribus singula bractea suffultis. Corolla 4- ad 7-petala. Antherae basifixae, loculis 2 vel 4 continuis vel locellatis.

The genus *Helixanthera* is spread all over the Philippines, and is represented there by three species, but it is only rarely met with in Mindanao. Outside the Philippines it is widely spread in the southeastern part of the Asiatic Continent, in the western half of the Malay Archipelago, and in tropical and subtropical Africa.

### *Key to the Philippine species of Helixanthera.*

1. Flowers quite sessile in many-flowered spikes.................. 2. *H. sessiliflora*.
Flowers more or less pedicelled.................................................................. 2.
2. Flower in many-flowered racemes; free part of the filament distinct; anther not more than three times as long as broad; style constricted somewhat below the middle............................................. 1. *H. parasitica*.
Flowers in at most 6-flowered racemes; anthers sessile, linear; style not constricted .................................................................. 3. *H. tenuis*.

### 1. HELIXANTHERA PARASITICA Loureiro.

*Helixanthera parasitica* LOUR., Fl. Conchinchin. **1** (1790) 142; SPRENG., Syst. (1825) 755; DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 318; **11** (1931) 381; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 **29** 6 (1933) 58.

*Helicia parasitica* PERS., Synopsis **1** (1805) 214.

*Loranthus pentapetalus* ROXB., Fl. Ind. ed. 1 **2** (1824) 211; FER.-VILL., Nov. App. (1880) 183; VIDAL, Pl. Cuming. Philip. (1885) 78, 140; Rev. Pl. Vasc. Filip. (1886) 231; MERR., Philip. Journ. Sci. **1** Suppl. (1906) 50; § C **4** (1909) 133; MERR. and MERRITT, Philip. Journ. Sci § C **5** (1910) 345; MERR., Journ. Str. Br. Roy. As. Soc. Special No. 1921 (1921) 239; Enum. Philip. Fl. Pl. **2** (1923) 108.

*Loranthus erythrostachys* SCHULT., Syst. **7** 1 (1829) 103.

*Loranthus polycarpus* SCHULT., Syst. **7** 2 (1830) 1651.

*Dendrophthoe pentapetala* G. DON, Gen. Hist. Dichl. Pl. **3** (1834) 419.

*Lanthorus spicifer* PRESL, Epim. Bot. (1849) 257; WALP., Annal. **2** (1852) 729; VAN TIEGH., Bull. Soc. Bot. Fr. **41** (1894) 487.

*Phoenicanthemum pentapetalum* MIQ., Fl. Ind. Bat. **1** 1 (1856) 823.

*Loranthus spicifer* FER.-VILL., Nov. App. (1880) 183; VIDAL, Pl. Cuming. Philip. (1885) 67, 140; Rev. Pl. Vasc. Filip. (1886) 231; MERR., Philip. Journ. Sci. § C **3** (1908) 405.

*Lanthorus pentapetalus, pentasepalus, polycarpus, Blumeanus, Cumingii,* VAN TIEGH., Bull. Soc. Bot. Fr. **41** (1894) 488.

*Leucobotrys inflata* and *adpressa* VAN TIEGH., Bull. Soc. Bot. Fr. **41** (1894) 503, 504.

*Loranthus inflatus, adpressus, Blumeanus, Cumingii* ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 128.

For a more extensive list of literature see Bull. Jard. Bot. Buitenzorg III **11** (1931) 381.

Omnis gabra, exceptis inflorescentiis floribusque juventute densissime brevissimeque puberulis. Ramuli ramosissimi, internodii junioribus basi teretibus apicem versus valde applanatis ancipitibus, vetustioribus semper magis cylindricis nodis valde incrassatis, folia adulta ferentibus plerumque 1.5 ad 7 cm longis, basi 1.5 ad 3 mm crassis, apicem versus ad duplo latioribus. Folia opposita vel subopposita; petiolus supra basin paulum incrassatam teres supra leviter applanatus, laminam versus supra magis applanatus vel leviter canaliculatus, 10 ad 20 mm longus 1 ad 1.5 mm crassus; lamina ovata ad ovato-lanceolata, 3 ad 12 cm longa, 1 ad 5.5 cm lata, basi rotundata vel cuneata, apicem obtusiusculum versus magis vel minus acuminata, tenuiter coriacea, fractione haud fibrosa, utraque facie opaca vel sublucida, penninervis, facie superiore nervis omnibus paulum prominentibus distinctis, inferiore costa valde prominente nervis lateralibus crassioribus plerumque distinctis. Inflorescentiae racemosae, gregatim in nodis defoliatis; axis 3 ad 10 mm longus, in 5 ad 10 mm inferioribus nudus teres sulcatus 0.75 ad 1.25 mm crassus, apicem versus paululum attenuatus, magis sulcatus, insertioribus florum paulum incrassatis; pedicelli sparsa sed magis minusve ad 4 ad 5 in verticillos aggregati, numerosi, 0.5 ad 1.5 mm longi, post anthesin ad 2 mm longi, 0.5 ad 0.75 mm crassi, basi et apice paulo crassiores quam medio, obtuse 3- vel 4-anguli, juventute paulum adpressi, post divergentes vel paulum reflexi post anthesin saepe valde reflexi; bractea in prolongatione pedicelli, cupuliformis, dorso gibbera, apice breve acuminata, c. 1 mm longa, saepe fimbriata. Flos juventute axi adpressus, postea divergens; calicis tubus globoso-campanulatus, 1.25 ad 1.5 mm latus; limbus erectus vel margine paulum patens fimbriatus, integer, c. 0.5 mm longus. Corolla statu alabastri adulti c. 4 ad 5.5 mm longa, composita ex 2 partibus globosis parte cylindrica connexis, parte inferiore obtuse 5-angula lateribus cavis, c. 1.5 ad 2 mm longa et lata, parte superiore paulum obovata obtusissima c. 1.25 ad 2 mm longa subaequilata; postea dehiscens in petala 5 parte inferiore facie exteriore late elliptica cava, facie interiore carinata carina anguste sulcata (in qua carina styli quadrat), apice carinae gibberositate rugosa (quae in constrictione styli quadrat); parte media facie exteriore plana, facie interiore filamento adnato distincto; parte superiore reflexa oblonga, acutiuscula, facie exteriore convexa interiore excavatione (in qua anthera quadrat). Filamenti pars libera c. 1 mm longa; anthera elliptica apice basique obtusissima, mox valde abbreviata extrorsim curvata, loculis 4 continuis. Stylus 3 ad 4.5 mm longus, 0.4 partibus inferioribus sulcis 5 carinisque 5 parte superiore crenatis, supra eam partem constrictus, supra constrictionem incrassatus carinis 5 crenatis, apicem versus ecarinatus levis; stigma parte styli superiore fere duplo crassius, truncatum. Fructus ellipsoides vel obovoides, ad 8 mm longus, 5 mm crassus, apice basique rotundatus, calicis limbo vix aucto coronatus; exocarpium induratum fragile; endospermium oblongum vel oblongo-obovatum, c. 4 mm longum, 2 mm crassum.

In Bull. Jard. Bot. Buitenz. III 11: 382, second line of the description, I wrongly wrote, "all parts bearded on the fracture." This should be transferred to the description of *H. valida* on page 390.

The above description is made exclusively from Philippine material. There are certainly small differences between the Philippine plants and those from the Malay Peninsula, Sumatra,

and Java, but these differences are too slight to base a separate species upon. There is no transition form towards the Bornean *H. xestophylla,* and the Philippine specimens with the largest flowers are not those from Negros and Mindanao, but those from Camarines Sur (*Bur. Sci. 76073,* with the style up to 4.5 mm long), and the proportions of their flowers are as in *H. parasitica,* not as in *H. xestophylla.*

The distribution of *H. parasitica* in the Philippines is peculiar; it chiefly occurs in Luzon; it is much rarer in the southern islands Negros, Panay, and Mindanao, and has not been found in the western islands and Palawan. It is collected from low altitudes to 1,800 m elevation.

The flower color of *H. parasitica* is indicated on the herbarium labels usually as red, but not rarely as white, greenish white, yellowish white, or even golden yellow. The fruit is indicated several times as red.

Philippines, without exact locality, *Cuming 1949* (M, NY, L), cotypes of *Lanthorus spicifer* Presl, *Cuming 1975* (M), cotype of *Lanthorus Cumingii* Van Tiegh. LUZON, Ilocos Norte Province, Magalis, Batac, on the mountain, 850 m altitude, *F. B. 22983 Adduru* (M): La Union Province, Bauang, *Fénix 118* (M): Mountain Province, Bontoc, 900 to 1,200 m altitude, *F. B. 16524 Curran and Merritt* (M); Mount Pukis, 1,800 m altitude, *Bur. Sci. 37830 Ramos and Edaño* (M, NY); Bauco, 1,400 m altitude, *Vanoverbergh 1370* (M, L): Benguet Subprovince, Baguio, *Elmer 8493* (M, NY, B, L) and *8718* (NY, B, L); *F. B. 4901 Curran* (M), *Sandkuhl 187* (M), *Clemens s. n.* (UC); Mountain Trail, Km 8–10, *Bur. Sci. 78081 Quisumbing* (M); Kapungun to Sagpat, *Clemens 17146* (M, UC, NY); Kias Hill, *Williams 932* (M, NY); Sablang, *Fénix 470* (M, L, U, Br); Ambuklao to Daklan, *Merrill 4402* (M, NY); Mount Pulog, 1,150 m altitude, *F. B. 16231 Curran, Merritt, and Zschokke* (M, L, B); Mount Santo Tomas, 1,500 m altitude, *F. B. 14406* Darling (M, NY): Cagayan Province, Peñablanca, low altitude, *Bur. Sci. 76735 Ramos* (M); Anggapang River, Gonzaga, 300 m altitude, *Bur. Sci. 78243 Edaño* (M): Zambales Province, Mount Canaynayan, Castillejos, 55 mm altitude, *Bur. Sci. 26820 Edaño* (M, NY, B); Mount Tapolao, 600 m altitude, *Bur. Sci. 44712 Ramos and Edaño* (M, UC, NY, S): Bataan Province, Limay, *F. B. 19133 Curran* (M, B, L); Mariveles, *Warburg 33634* (Be); Lamao River, 100 m altitude, *F. B. 80 Barnes* (M, NY, B, S); Lamao River, Mount Mariveles, *Whitford 1219* (M), 45 altitude, *F. B. 2243*

*Meyer* (M, NY, B); Mount Mariveles, near summit, *Elmer 6891* (M, NY): Pampanga Province, Mount Abu, 500 m altitude, *Bur. Sci. 1993 Foxworthy* (M): Rizal Province, *Loher 14482* (M, B); Bosoboso, *Merrill 1832* (M, NY), *F. B. 2134 Ahern's coll.* (M, NY, B, S); Mount San Isidro, *Bur. Sci. 1499 Ramos* (M, NY, B); Montalban, *Loher 12788* (M); Pinauisan, *Loher 12422* (M, UC): Laguna Province, San Antonio, *Bur. Sci. 16531* (M, B, L) and *16532* (Br, G, wrong No. 7) *Ramos;* Lilio, *De Leon 4075* (M); Paete, 100 to 200 m altitude, *Bur. Sci. 22823 McGregor* (M): Tayabas Province, Lucban, *Elmer 9174* (M, NY, B, L, U); Piis, 500 m altitude, *F. B. 27368 Sulit* (M, UC); Mount Binuang, 34 m altitude, *Bur. Sci. 28545 Ramos and Edaño* (M, B): Camarines Norte Province, Paracale, low altitude, *Bur. Sci. 33521 Ramos and Edaño* (M): Camarines Sur Province, Ingas, 12 m altitude, *F. B. 28719 Simeon* (M, B); Kolago River, 450 to 480 m altitude, *Bur. Sci. 76073* (M) and *76075* (NY) *Edaño:* Sorsogon Province, Mount Bulusan, Irosin, *Elmer 17224* (M, UC, B, L, U). CATANDUANES, Mount Mariguidon, 400 m altitude, *Bur. Sci. 30199 Ramos* (M). POLILLO, *Bur. Sci. 10333* (M, B, L), and *10350 McGregor* (M, NY). PANAY, Iloilo Province, Ulian River, 320 m altitude, *Bur. Sci. 18176 C. B. Robinson* (M). NEGROS, Oriental Negros Province, Cuernos Mountains, Dumaguete, *Elmer 10390* (NY, B, L). MINDANAO, Misamis Province, Mount Catmon, 100 m altitude, *F. B. 17967 Miranda* (M).

Further distribution: Assam, Conchin China, Malay Peninsula, Sumatra, and Java.

### 2. HELIXANTHERA SESSILIFLORA (Merrill) Danser.

*Loranthus sessiliflorus* MERR., Philip. Journ. Sci. 1 Suppl. (1906) 188; § C 4 (1909) 133; Enum. Philip. Fl. Pl. 2 (1923) 110.

*Helixanthera sessiliflora* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 318; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 59.

Omnis glabra. Ramuli valde ramosi, internodiis 1.5 ad 6 cm longis, folia adulta ferentibus basi teretibus 2 ad 3.5 mm crassis, juvenilibus apicem versus applanatis et dilatatis ad duplo latioribus, vetustioribus teretibus nodis incrassatis. Folia opposita, breve petiolata vel subsessilia; petiolus difficile a lamina distinguendus, subtus rotundatus supra applanatus, 0 ad 10 mm longus, 2 ad 2.5 mm latus; lamina rotundato-elliptica basi attenuata vel magis obovata, 4 ad 12 cm longa, 2 ad 6 cm lata, basi sensim attenuata, apice rotundata vel apicem obtusum versus breve acuminata, crassiuscula, fragilis, utrinque opaca vel sublucida, frac-

tione haud fibrosa, costa facie inferiore magis prominente quam superiore, nervis ceteris utraque facie invisibilibus vel crassioribus supra visibilibus. Inflorescentiae spicatae, rarius singulae in axillis foliorum, vulgo gregatim in axillis foliorum vetustiorum et in nodis defoliatis; axis irregulariter angulosus et sulcatus, 20 ad 40 mm longus, basi 1 ad 1.5 mm crassus, apicem versus vix attenuatus, insertionibus florum non incrassatis, in 2 ad 10 mm inferioribus nudus, ceterum floribus numerosis densiuscule positis; bracteae suborbiculares, oblique cupuliformes, calicis basi adpressae, c. 0.75 mm longae. Flores semper divergentes, sparsi sed magis vel minus ad 5 inverticilos congregati. Calicis tubus breve campanulatus, c. 1 mm longus et latus; limbus brevissimus, integer, erectus vel paulum infundibuliformis. Corolla statu alabastri adulti 3.5 ad 5 mm longa, dimidia parte inferiore paulum dilatata ad 0.75 mm lata, 4- vel 5-angula lateribus subplanis, medium versus paulum attenuata, dimidia parte superiore iterum 0.75 mm crassa, 4- vel 5-angula, lateribus convexis, obovata, apice rotundata, postea partita in petala 4 vel 5 parte inferiore paulum patentia, medio reflexa, parte apicali incurvata, c. 0.5 mm lata, medio paulum attenuata, apice subacuta, facie interiore parte inferiore vix incrassata, medio gibbera verruculosa, parte superiore cava. Filamenti pars libera 0.5 ad 0.75 mm longa; anthera rotundato-oblonga, c. 1 mm longa, mox contracta et extrorsim curvata, apice rotundata, loculis 4 continuis. Stylus 3 ad 4.5 mm longus, a basi ad apicem paulum incrassatus, haud constrictus, obtuse 4- vel 5-angulus; stigma styli apice paulo crassius, obtusissimum, subtruncatum. Fructus ovoides, maximus 5 mm longus, 3.5 mm latus, apice truncatus et calicis limbo false dentato (vero locis 4 vel 5 inflexis) coronatus, exocarpio coriaceo, mesocarpio viscoso, nulla parte indurata.

*Helixanthera sessiliflora* has been collected in northern and central Luzon and in Polillo, Mindoro, and Negros, from sea level to 1,600 m altitude. The color of the flowers is indicated on herbarium labels as red or pale red, inserted on a yellow axis.

LUZON, Mountain Province, Bontoc, Mount Masapilig, 900 m altitude, *Bur. Sci. 37901 Ramos and Edaño* (M, B); Benguet Subprovince, Baguio, *Williams 1293* (NY); Tublay, *Elmer 6057* (M, NY, S); Malawey, Pinggat, 1,600 m altitude, *Vanoverbergh 480* (M): Isabela Province, Mount Moises, *Clemens 16709* (UC): Zambales Province, Castillejos, *Comisión de la Flora forestal de Filipinas No. 542* (L): Nueva Vizcaya Province, Caraballo

Mountains, *Loher 13629* (M): Nueva Ecija Province, Mount Umingan, 400 m altitude, *Bur. Sci. 26298 Ramos and Edaño* (M): Bataan Province, Mount Mariveles, Lamao River, 1,000 m altitude, *Whitford 1171* (M), type of *Loranthus sessiliflorus* Merr.: Rizal Province, Montalban, *Loher 12536* (M): Laguna Province, Mount Banahao, 1,376 m altitude, *Bur. Sci. 27933* (M) and *27943* (M, UC), *Ocampo;* 1,500 m altitude, *Bur. Sci. 9795 C. B. Robinson* (M, B, L); first camp, *Quisumbing 1259* (M): Tayabas Province, Sampaloc, *Warburg 13126* (Be); Lucban, *Elmer 7845* (M, NY, B, L); Casiguran, low altitude, *Bur. Sci. 45552 Ramos and Edaño* (M, NY, UC); Mount Binuang, 150 m altitude, *Bur. Sci. 28470 Ramos and Edaño* (M, B); 300 m altitude, *Bur. Sci. 28734 Ramos and Edaño* (M, B). POLILLO, 15 m altitude, *F. B. 29713 Salvoza* (M, UC). MINDORO, Agluban River, 150 m altitude, *F. B. 11499 Merritt* (M); Baco River, *McGregor 125* (M, NY); *Merrill 4041* (M, NY, Be); Alinsanay, *Merrill 1242* (M, NY, Be). NEGROS, Oriental Negros Province, Cuernos Mountains, Dumaguete, *Elmer 10355* (B, NY, L).

### 3. HELIXANTHERA TENUIS (Merrill) Danser.

*Loranthus tenuis* MERR., Philip. Journ. Sci. S C 4 (1909) 136; Enum. Philip. Fl. Pl. 2 (1923) 110.

*Helixanthera tenuis* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 318; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 60.

Glabra, partibus valde juvenilibus breve densique ferrugineo tomentosis exceptis. Caules valde tenues ramosissimi, internodiis teretibus insertionibus foliorum nonnihil incrassatis, novissimis subangulatis, folia adulta ferentibus 0.6 ad 1 mm crassis, 3 ad 20 mm longis. Folia sparsa vel passim subopposita; petiolus difficile a lamina distinguendus, 0 ad 2 mm longus, 0.5 ad 0.75 mm crassus, supra paulum infra magis convexus; lamina lanceolata vel ovato-lanceolata, 3 ad 6 mm longa, 0.5 ad 1.8 cm lata, valde in petiolum attenuata, apicem obtusum versus magis minusve acuminata, nonnunquam in acumen lingulatum protracta, chartacea vel tenuiter coriacea, fragilis, utraque facie opaca, facie superiore costa prominente nervis crassioribus partim distinctis, inferiore costa magis prominente nervis lateralibus minus distinctis. Inflorescentiae racemi simplices pauciflori pedunculati in axillis foliorum; pedunculus 9 ad 11 mm longus, 0.2 ad 0.3 mm crassus; axis florifer 0 ad 6 mm longus, 2 ad 5 flores sparsos vel in paribus decussatis dispositos (si 3 subumbellatos) ferens;

pedicelli 1 ad 1.5 mm longi; bractea ovata obtusissima, c. 0.75 mm longa, subuncinata, valde convexa. Calicis tubus rotundato-campanulatus, c. 1 ad 1.25 mm longus et latus, sub limbo paulum constrictus; limbus infundibuliformis, c. 0.25 mm longus, integer. Corolla statu alabastri adulti 5.5 ad 6 mm longa, in 1.5 ad 2 mm inferioribus paulum dilatata c. 1 mm lata quadrangula, ceterum cylindrica c. 0.75 mm lata, apice rotundata, postea partita in petala 4 parte inferiore dilatata intus plana, supra partem dilatatam marginibus membranaceis inflexis, parte superiore intus concava; anthera sessilia, linearia, 2.5 mm longa, obtusa, loculis (probabiliter) 2 continuis. Stylus a basi coniforme 0.5 mm longa aequicrassus, omnis c. 5.5 mm longus; stigma a stylo valde distinctum, globosum, fere 0.5 mm crassum. Fructus globoso-ovoides, ad 3.5 mm longus, 3 mm crassus, calicis limbo brevi et disco (styli basi) exserto coronatus.

The description is made from the type, with exception of the fruit, which is made from the second specimen. Whereas the type specimen bears flower buds and open flowers, the second specimen bears small flower buds and fruit. As the further differences are unimportant and the localities are not far remote I do not doubt the specific identity of the specimens.

Merrill considered the inflorescences as solitary triads and so could not understand the true relationships of this remarkable species. Most closely related are *Helixanthera ligustrina, H. terrestris,* and *H. subligustrina* from the Asiatic Continent. J. D. Hooker[5] describes both *H. ligustrina* and *H. terrestris* as rather robust terrestrial shrubs, with flowers $\frac{1}{3}$ inch long; *H. tenuis* has flowers 7.5 mm long, and on the herbarium label nothing is said about a terrestrial habit. With *H. ligustrina* it agrees in the ferrugineous pubescence of the inflorescences, with *H. terrestris* in the thinner texture of the leaves. Lecomte[6] describes a closely allied species, *H. subligustrina,* the description of which, in several respect, agrees still more with *H. tenuis,* and Lecomte even describes the inflexed membranous margin of the petals, but the figure he gives is different, showing an anther 2 mm long about 2 mm remote from the inflexed margin, whereas *H. tenuis* has an anther 2.5 mm long reaching with its base to the inflexed margin; moreover, *H. subligustrina* has its flowers in spikes, *H. tenuis* rather long-pedicelled in racemes. Perhaps all these species will prove to be forms of one species.

[5] Fl. Br. Ind. 5: 208.

[6] Not. Syst. 3: 71, 174.

LUZON, Bataan Province, Lamao Forest Reserve, *F. B. 6287 Curran* (M, type, NY, Be, cotypes of *Loranthus tenuis* Merr.), flower red: Rizal Province, Morong, *ex Herb. Ateneo Manila No. 217* (M).

### X. Genus DENDROPHTHOE Martius

*Lonicera* GAERTN., Fruct. and Sem. 1 (1788) 132 non Linn. (1753).

*Dendrophthoe* MART., Flora 1830 1 (1830) 109; p. p.; MART. ex Blume, in Schult. Syst. 7 2 (1830) 1613; p. p.; BLUME, in Schult, Syst. 7 2 (1830) 1720 p. p.; DON, Gen. Hist. Dichl. Pl. 3 (1834) 402, 418 p. p.; MIQ., Fl. Ind. Bat. 1 1 (1856) 810 p. p. Suppl. Sum. (1860) 137, 344 p. p.; VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 143; 42 (1895) 85, 87, 242, 251, 270, 271; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 292, 307, 357, 367; 11 (1931) 397; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 43.

*Etubila* RAFIN., Sylva Tell. (1838) 125 p. p.

*Meiena* RAFIN., Sylva Tell. (1838) 125.

*Oedina* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 242, 249, 270, 271.

Inflorescentia recemosa vel spicata, floribus singula bractea suffultis. Corolla sympetala 5-meres, statu alabastri adulti parte inferiore dilatata, parte media angustata, parte apicali clavata. Antherae basifixae, loculis 4 vulgo continuis raro locellatis. Fructus ovatus, exocarpio coriaceo, mesocarpio viscoso, endocarpio sub endospermio in cupulam lignosam indurato.

The genus *Dendrophthoe* has a large area of distribution; from the Philippines it reaches southeastward to Australia, westward and southwestward to tropical Africa. In the Philippines it is represented by five species.

*Key to the Philippine species of Dendrophthoe.*

1. Corolla 65 to 70 mm long........................................ 4. *D. longituba.*
Corolla 30 to 47 mm long........................................ 3. *D. Clementis.*
Corolla 22 to 24 mm long........................................ 2. *D. Mearnsii.*
Corolla nearly 19 mm long; flower bud with five wings.
5. *D. mirifica.*
Corolla 13 to 15 mm long; flower bud without wings.
1. *D. pentandra.*

### 1. DENDROPHTHOE PENTANDRA (Linnæus) Miquel.

*Loranthus pentandrus* LINN., Mantissa 1 (1767) 63; FER.-VILL., Nov. App. (1880) 184; MERR., Philip. Journ. Sci. § C 4 (1909) 141; 15 (1919) 232; Enum. Philip. Fl. Pl. 2 (1923) 108.

*Loranthus farinosus* DESR., in Lam., Encycl. méth. Bot. 3 (1789) 597.

*Loranthus venosus* BL., Verh. Bat. Genootsch. 9 (1823) 188.

*Loranthus flavus* BL., Bijdr. 13 (1825) 661.

*Loranthus rigidus* DC., Prodr. 4 (1830) 298.

*Dendrophthoe farinosus* and *venosus* MART., Flora 1830 1 (1830) 110

*Scurrula venosa* and *pentandra*, *Elytranthe rigida* and *farinosa* G. DON, Gen. Hist. Dichl. Pl. 3 (1834) 424.
*Meiena axillaris* RAFIN., Sylva Tell. (1838) 125.
*Loranthus farinaceous* GRIFF., Ic. Pl. As. 4 (1854) 620 t.
*Dendrophthoe pentandra* MIQ., Fl. Ind. Bat. 1 1 (1856) 818; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 310; 11 (1931) 417; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 47.
*Dendrophthoe leucobotrya* MIQ., Fl. Ind. Bat. Suppl. Sum. (1860) 138, 345.
*Loranthus crassus* HOOK. F., Fl. Brit. Ind. 5 (1886) 217.
*Loranthus Zimmermanni* WARB., in De Wildeman, Pl. Nov. Herb. Hort. Ten. 2 (1909) 73, t. 82.
*Loranthus shawianus* ELMER, Leafl. Philip. Bot. 5 (1913) 1807.
For a more extensive list of synonyms cfr. Bull. Jard. Bot. Buitenzorg III 11: 417.

Glabra, exceptis ramulis foliisque valde juvenilibus magis minusve albido stellato pubescentibus et floribus inflorescentiisque juventute densissime tomento stellato post tenuescente vestito. Ramuli teretes, ad insertiones foliorum primum dilatati post incrassati, internodiis folia adulta ferentibus plerumque 1 ad 12 cm longis, 2 ad 4 mm crassis, vetustioribus crassioribus teretibus nodis incrassatis. Folia sparsa vel in ramulis minus prolongatis magis vel minus opposita; petiolus supra basin paulum incrassatam teres, laminam versus supra applanatus, 2 ad 8 mm longus, 1 ad 1.5 mm crassus; lamina plerumque elliptica vel oblonga, 4 ad 15 cm longa, 2 ad 8 cm lata, basi attenuata, apice obtusa vel rotundata, nonnunquam irregularis, crassiuscula, fragilis, utraque facie opaca, penninervis, nervatione saepe irregulari, costa semper supra distincta subtus prominente, nervis lateralibus venisque distinctis vel indistinctis vel invisibilibus. Inflorescentiae singulae vel paucae in axillis vel gregatim in nodis defoliatis; axis ad 15 mm longus, c. 0.75 mm crassus, apicem versus paulum attenuatus, in 2 ad 10 mm inferioribus nudus, ceterum floribus ad 10 sparsis in incrassationibus insertis; pedicelli teretes, 2 ad 4 mm longi, c. 0.5 mm crassi, basi incrassati; bracteae ovatae vel suborbiculares, 1 ad 2 mm longae, obtusae vel acutae, basi amplexicaules et nonnihil cupuliformes. Calicis tubus cylindricus vel urceolatus, plerumque 1.5 ad 2.5 mm longus, 1 ad 1.75 mm latus; limbus juventute cylindricus integer vel subinteger, postea inflatione corollae infundibuliformis et laceratus, 1 ad 1.5 mm longus. Corolla statu alabastri adulti 13 ad 15 mm longa, dimidia parte inferiore diu cylindrica, ante anthesin inflata ad 4 mm lata, ovoidea vel ellipsoides, saepe plicis 5 longitudinalibus, dimidia parte superiore ellipsoides 5-angula, c. 1.5 mm crassa, obtusissima, postea partita usque ad tubum 3 ad 5 mm longum in lacinias 5 parte basali anguste triangulas, supra spathulatas, apice crassiusculas acutas, parte angustiore margine floccoso denticulato recurvatas. Filamenti pars libera 2 ad 3 mm longa; anthera 1.5 ad 2.5 mm longa, obtusa, loculis 4 continuis. Stylus corollae subaequilongus, a basi ad stigma aequicrassus; stigma subglobosum vel depressum, stylo sesquiplo vel duplo crassius. Fructus ovoides, ad 10 mm longus, 5 mm crassus, basi subtruncatus, apicem versus saepe subconicus, calicis limbo permanente paulum acuto coronatus, exocarpio coriaceo, mesocarpio viscoso, endocarpio sub semine in cupulam lignosam indurato.

The above description is chiefly from Philippine material, especially as to the dimensions, which in the specimens of the Netherlands Indies vary much more. The form of *D. pentandra* met with in the Philippines is the most common one, widely spread in the further area of distribution, and is only remarkable by rather small flowers.

In the Philippines *D. pentandra* is restricted to Palawan and few localities in Luzon.

Philippines, without exact locality, *Cuming 1962* (M), *2323* (Be). LUZON, Zambales Province, Subic, *Hallier 243* (M, NY). PALAWAN, Puerto Princesa, *Bur. Sci. 283 Bermejos* (M, NY, B, Be); *Bur. Sci. 45965 McGregor* (UC, NY); Iwahig River, *Merrill 692* (M, NY, Be); Addison Peak, Brooks Point, *Elmer 12610* and *12699* (M, NY, B, L, U, Be), cotypes of *Loranthus shawianus* Elm.

Further distribution: Tropical southeastern Asia; western part of the Malay Archipelago.

### 2. DENDROPHTHOE MEARNSII (Merrill) Danser.

*Loranthus mearnsii* MERR., Philip. Journ. Sci. § C 2 (1907) 271; § C 4 (1909) 136; Enum. Philip. Fl. Pl. 2 (1923) 106.

*Dendrophthoe Mearnsii* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 310; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 47.

Glabra, exceptis ramulis foliisque tomento stellato tenui denso vestitis mox glabrescentibus et inflorescentiis floribusque aliquo modo vestitis partibus valde excrescentibus tantum glabrescentibus. Internodia teretia, nodis paulum incrassatis, quae folia adulta ferunt plerumque 1 ad 2 cm longa, 2 ad 4 mm crassa.

Folia sparsa; petiolus supra basin paulum incrassatam teres, laminam versus supra magis applanatus quam subtus, plerumque 1 ad 1.5 mm crassus, difficile a lamina distinguendus, plerumque 5 ad 10 mm longus; lamina plerumque elliptica, 4 ad 8 cm longa, 2 ad 5.5 cm lata, basi in petiolum attenuata, apice obtusa, tenuiter coriacea, fragilis, utraque facie opaca, penninervis, nonnunquam paulum survinervis, costa subtus valde supra minus prominente, nervis lateralibus crassioribus utrinque prominentibus distinctis, tenuioribus minus distinctis. Inflorescentiae (quoad notae) in axillis foliorum singulae; axis ad 12 mm longus, basi 0.5 mm, apicem versus 0.25 mm crassus, parte c. dimidia inferiore nudus, parte superiore floribus ad 5 in incrassationibus levibus insertis; pedicelli 2.5 ad 3.5 mm longi, teretes; bracteae ovatae, paulum amplexicaules acutissimae, vel subovatae, 1.5 mm longae, basi c. 1 mm supra paulo minus latae; limbus cupuliformis vel subinfundibuliformis 1.25 ad 1.5 mm longus, dentibus 5 obtusis distinctis, nonnunquam inter dentes laceratus. Corolla statu alabastri adulti 22 ad 24 mm longa, duabus tertiis inferioribus fusiformiter inflata ad 3.5 mm lata, tertia parte superiore primum in collum 1.25 mm latum constricta, deinde in clavam ellipsoidem 5-angulam subacutam 2 mm crassam incrassata, postea ad dimidiam longitudinem dehiscens in lacinias 5 in parte angustissima recurvatas, parte inferiore anguste triangulares, parte superiore anguste lanceolatas acutas. Filamenti libera 4 mm longa; anthera c. 3.5 mm longa, linearis, obtusa, loculis 4 continuis. Stylus corollae aequilongus; stigma breve ellipsoides, stylo sesquiplo vel duplo crassius, obtusum. Cetera ignota.

*Dendrophthoe Mearnsii,* though very different from *D. pentandra* as it is found in the Philippines, is perhaps not to be distinguished from certain forms of the latter species from Borneo, that have longer flowers and are rusty-hairy, and that in my revision of the Loranthaceæ of the Netherlands Indies I shortly discussed on page 406, lines 18 to 25 from the top. From these forms *D. Mearnsii* differs, however, by more slender pedicels and longer, more infundibuliform calices.

Merrill describes the flowers of *D. Mearnsii* as 4-merous; what I could examine was, at least for the greater part, 5-merous, though it seemed to me that also 4-merous flowers occur.

MINDORO, Mount Halcon, 1,800 m altitude, *Merrill 5733* (M, type, NY, Be, cotypes, of *Loranthus Mearnsii* Merr.), tips of flowers red, rest green.

### 3. DENDROPHTHOE CLEMENTIS (Merrill) Danser.

*Loranthus curvatus* Fer.-Vill., Nov. App. (1880) 184; Vidal, Pl. Cuming. Philip. (1885) 77, 141; Rev. Pl. Vasc. Filip. (1886) 230; non Blume (1825).
*Loranthus ampullaceus* Vidal, Pl. Cuming. Philip. (1885) 77, 141.
*Loranthus globosus* Vidal, Rev. Pl. Vasc. Fil. (1886) 230.
*Loranthus clementis* Merr., Philip. Journ. Sci. 1 Suppl. (1906) 185; § C 4 (1909) 140; Enum. Philip. Fl. Pl. 2 (1923) 103.
*Loranthus clementis* Merr., Philip. Journ. Sci. 1 Suppl. (1906) 186; § C 4 (1909) 140; Merr. and Merritt, Philip. Journ. Sci. § C 5 (1910) 345; Merr., Enum. Philip. Fl. Pl. 2 (1923) 103.
*Loranthus hallieri* and *loheri* Merr., Philip. Journ. Sci. § C 4 (1909) 140; Enum. Philip. Fl. Pl. 2 (1923) 105, 106.
*Dendrophthoe Clementis, Copelandii, Hallieri, Loheri* Dans., Bull. Jard. Bot. Buitenzorg III 10 (1929) 307–310; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 44, 46.

Glabra, exceptis inflorescentiis floribusque juvenilibus plerumque tomento stellato denso tenui albido nonnunquam floccoso vestitis, postea glabrescentibus, sed calicis tubus semper tomentosus. Internodia teretia nodis incrassatis, plerumque 1 ad 6 cm longa, quae folia adulta ferunt 1 ad 5 mm crassa. Folia sparsa petiolata vel opposita sessilia; petiolus supra basin incrassatam teres, laminam versus supra paulum applanatus, 6 ad 12 mm longus, 0.6 ad 3 mm crassus; lamina elliptica vel triangulari-ovata vel magis rotundata ad lanceolata, 2.5 ad 18 cm longa, 1.5 ad 7 cm lata, basi cordato-amplexicaulis ad attenuata, chartacea vel coriacea, opaca, fragilis, penninervis, nervatura utraque facie omnino visibili vel nervis tenuioribus invisibilibus, costa facie inferiore magis prominente quam superiore, nervis lateralibus inferioribus in laminis cordatis saepe valde incurvatis. Inflorescentiae paucae in axillis foliorum vel gregatim in nodis vetustioribus, raro passim terminales in apicibus ramulorum axillarium; axis ad 75 mm longus, basi incrassatus, parte inferiore 0.5 ad 0.75 mm crassus, apicem versus tenuior, insertionibus florum incrassatis; pedicelli teretes, fere 0 ad 4 mm longi, c. 0.3 mm crassi, numerosi (ad 50); bracteae ovatae vel oblongo-ovatae, c. 0.75 ad 1.25 mm longae, acutae vel acuminatae vix amplexicaules. Calicis tubus 1.5 ad 1.75 mm longus, fere 1 mm latus, ovato-campanulatus, basi obtusissimus, limbum versus fere conicus; limbus erectus vel cupulatus, 0.5 ad 0.75 mm longus, plerumque distincte obtuse 5-dentatus, glabritie a tubo valde distinctus. Corolla statu alabastri adulti 30 ad 47 mm longa, tota longitudine incurvata, a basi c. 0.75 mm lata ad duas tertias longitudinis sensim ad 2 mm dilatata, ibi 5-angula vel plicis 5 longitudinalibus, deinde paulum attenuata denique in clavam subgracilem subobtusam vel acutam c. 5 mm longam, 0.75 mm crassam incrassata, postea dehiscens usque ad partem latissimam in lacinias 5 recurvatas vel etiam revolutas, anguste lineares, obtusas, parte angusta margine floccoso. Filamenti pars libera 4 ad 5 mm longa; anthera 1.25 ad 3.25 mm longa, lanceolata, magis minusve acuta acuminata raro obtusa, loculis 4 continuis. Stylus filiformis, vix vel ad 2 mm longior quam corolla; stigma subglobosum, stylo sesquiplo vel duplo crassius. Fructus ovoides-conicus, ad 7 mm longus 5 mm crassus, basi subtruncatus, calicis limbo erecto paulum aucto coronatus, exocarpio coriaceo, mesocarpio viscoso, endocarpio sub semine in cupulam lignosam fere 5 mm latam 1.5 mm altam indurato.

Under the name *Dendrophthoe Clementis* I have united four species, the differences among which are insufficient for specific distinction, whereas intermediate forms occur. Rather strongly different is the form distinguished by Merrill as *Loranthus Hallieri,* by cordate-amplexicaulous leaves, but such forms also occur in other loranthaceous species (for example, *Dendrophthoe falcata* and *Macrosolen pseudoperfoliatus*).

*Dendrophthoe Clementis* is widely distributed in the Philippines, from Camiguin, north of Luzon, to central Luzon, Mindanao, and Palawan, but it has not been collected on other islands. It occurs from sea level to 1,500 m altitude. Merrill mentions his *Loranthus Hallieri* as *Hallier s. n.* from Basilan, but the type specimen in the Philippine National Herbarium is *Hallier 628* from Zamboanga, Mindanao.

The color of the corolla varies, according to the herbarium labels, from red with yellow tips to yellow with red tips or red with yellow neck and red tips.

The only species to which *Dendrophthoe Clementis* is closely allied is *D. constricta,* from Borneo and Celebes, but this is a coarser plant with smaller flowers.

Philippines, without exact locality, *Cuming 1946, 1955, 1963* (M), *1965* (M, L). CAMIGUIN (Babuyan Islands), *Bur. Sci. 4111 Fénix* (M). LUZON, (Eurike ? "northern Luzon"), *Warburg 12122* (Be): Ilocos Norte Province, *Bur. Sci. 2288 Mearns* (M); Bangui, *Bur. Sci. 43600 McGregor* (M, UC), 10 m altitude, *Bur. Sci. 27482 Ramos* (M, NY, B, L): Benguet, Subprovince, Daklan to Kabayan, 1,500 m altitude, *Merrill 4407*

(M, type, NY, Be, cotypes of *Loranthus copelandi* Merr.) ; Mount Pulog, 1,350 m altitude, *F. B. 16232 Curran, Merritt, and Zschokke* (M, NY, L) : Cagayan Province, *Bur. Sci. 7847 Ramos* (L), *Bur. Sci. 7847 Ramos* (M, NY) ; Duyon, *Bur. Sci. 7826 Ramos* (M, type, Be, cotype of *Loranthus loheri* var. *ampla*) ; Peñablanca, *Adduru 87* (M), *Bur. Sci. 22744 Castillo* (M, NY), low altitude, *Bur. Sci. 46533 Ramos and Edaño* (M, NY, UC, S, B), *Bur. Sci. 46632 Ramos and Edaño* (M, NY, UC, S) ; Pinacanawan River, low altitude, *Bur. Sci. 76879 Ramos* (M) : Isabela Province, Simaun River, *F. B. 18577 Alvarez* (M) ; Santiago, *Clemens 18032* (UC) ; San Mariano, Dapinig, 1,200 m altitude, *Bur. Sci. 46805 Ramos and Edaño* (M, UC) ; Tumauini, *Wester 19083* (M) : Zambales Province, Anuling, low altitude, *Bur. Sci. 44582 Ramos and Edaño* (M, NY, UC, S, B) ; Olongapo, *Sandkuhl 21* (M) : Rizal Province, Rio San Francisco del Monte, *Loher 4481* (M), type of *Loranthus loheri* Merr.; Pasig River, Santa Mesa, *Hallier s. n.* (NY). MINDANAO, Lanao Province, Lake Lanao, Camp Keithley, 800 m altitude, *Clemens s. n.* (M, type, Be, cotype of *Loranthus clementis* Merr.) : Zamboanga Province, Zamboanga, *Hallier 628* (M, type, NY, cotype of *Loranthus hallieri* Merr.), *Merrill 814* (M, Be), *Elmer 12035* (M, NY, B, L, U) ; *Aldaba 19106* (M) ; low altitude, *Bur. Sci. 37455 Ramos and Edaño* (M, B, Be) ; Lambayao, 1 m altitude, *F. B. 30920* (M), *F. B. 30487* (M, NY, UC) *Mabesa and Espiritu* (probably twigs of the same individual, the peculiarities of the specimens, the field notes, and field number being quite the same) ; Santa Maria, *Bur. Sci. 16490 Reillo* (M). PALAWAN, Pabellones (in Taytay Bay), 0 m altitude, *Merrill 9437* (M) ; Apulit Island (in Taytay Bay), seashore, *Merrill 9432* (M, NY, B, S, L).

### 4. DENDROPHTHOE LONGITUBA (Elmer) Danser.

*Loranthus longituba* ELMER, Leafl. Philip. Bot. 6 (1913) 196; (*-bus*) MERR., Enum. Philip. Fl. Pl. 2 (1923) 106.

*Dendrophthoe longituba* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 310; 11 (1931) 415; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 47.

Ramuli robusti, internodiis teretibus nodis incrassatis, junioribus nodis applanatis, folia adulta ferentibus ad 3.5 cm longis, 2.5 ad 5 mm crassis. Folia sparsa, saepe subopposita raro opposita; petiolus teres, basi paulum incrassatus, prope laminam leviter canaliculatus, 15 ad 35 mm longus, 1.5 ad 2.5 mm crassus; lamina ovato-cordata, 11 ad 20 cm longa, 4.5 ad 9 cm lata, basi late et profunde cordata, apicem acutum versus acuminata, crasse

coriacea, opaca, costa et nervis lateralibus usque ad tertii ordinis facie inferiore valde facie superiore minus prominentibus, lateralibus incurvatis. Inflorescentiae floribusque juventute tomento denso ochraceo stellato, in corolla excrescente mox tenuescente, postea etiam in inflorescentiis tenuescente, in calicibus diu permanente, vestitae, nodis defoliatis insertae; axis teres, 3 ad 6 cm longus, ad insertiones florum leviter incrassatus, basi 2.5 ad 3 mm crassus, apicem versus ad 1 ad 1.5 mm attenuatus, omnino fere florifer, floribus sparsis; pedicelli 0.5 ad 1 mm longi, c. 0.75 mm crassi; bracteae triangulares, convexae, acutae, c. 1.5 mm longae. Calicis tubus campanulato-urceolatus, 1.5 ad 2 mm longus paulo minus latus; limbus paulum cupuliformis, c. 0.75 mm longus, leviter 5-dentatus. Corolla statu alabastri adulti 65 ad 70 mm longa, in 20 mm inferioribus cylindrica 2 mm lata, deinde fusiformiter dilatata ad 6 mm lata, denique in partem apicalem c. 12 mm longam 1.5 mm crassam prismaticam 5-angulam obtusam attenuata, tota longitudine incurvata, postea dehiscens in lacinias 5, ad c. 13 mm ab apice recurvatas vel etiam revolutas, sublineares, c. 0.8 mm latas, subacutas, parte angustissima margine floccoso, tubum c. 40 mm longum relinquens. Filamenti pars libera 6 ad 7 mm longa, glabra; anthera 5 ad 6 mm longa, e basi filamento aequilata sensim attenuata, apice acute acuminata. Stylus filiformis, 2 ad 3 mm longior quam corolla; stigma ellipsoides, obtusum, stylo paulo tantum crassius. Cetera ignota.

MINDANAO, Agusan Province, Mount Urdaneta, Cabadbaran, between Duros and Cawilanan Peaks, 1,500 m altitude, *Elmer 14053* (M, NY, B, L), cotypes of *Loranthus longituba* Elm.

Probably second specimen: MINDANAO, Surigao Province, Placer, 150 m altitude, *Wenzel 3027* (UC), flowers white. This specimen differs from the type by smaller and less cordate leaves; the flowers are in a very young state; the indication "flowers white" therefore probably concerns the indumentum, that in the herbarium specimen is ochraceous.

Further distribution: Borneo, Belitoeng.

### 5. DENDROPHTHOE MIRIFICA Danser sp. nov.

Glabra, exceptis inflorescentiis floribusque pilis stellatis ferrugineis vestitis, corollis tamen cum excrescunt mox sparse pilosis. Caulis (unicus notus) c. 30 cm longus, teres, nodis incrassatis, internodiis (omnibus folia adulta ferentibus) 1.5 ad 4.5 cm longis, 1.25 ad 2.5 mm crassis, levibus, substriatis. Folia sparsa; petiolus difficile a lamina distinguendus, 1 ad 3 mm longus, basi teres, prope laminam supra paulum applanata; lamina ovato-oblonga, 6 ad 11 cm longa, 2 ad 4.5 cm lata, basi cuneata vel sub basi rotundata in petiolum contracta, acuta, chartacea, utrinque opaca tenuissime granulata, subcurvinervis, paribus 2 nervorum lateralium prope costae basin orientibus, pari interiore usque fere ad apicem, pari exteriore ad dimidiam folii longitudinem percurrente, nervis venisque omnibus facie inferiore distincte superiore leviter prominentibus. Inflorescentiae numerosiores in axillis foliorum; pedunculus c. 0.75 mm longus 0.5 mm latus, paulum applanatus, apice flores 2 ferens vel supra flores 2 paulum prolongatus; pedicelli c. 0.75 mm longi, 0.3 mm crassi, teretes; bracteae rotundato-triangulares, acutae, convexae, 1 ad 1.25 mm longae, basi non cupulatae. Calicis tubus campanulatus, 1.25 mm longus, 1 mm latus, in herbario longitudinaliter rugosus; limbus erectus vel subinfundibuliformis, integer, c. 0.25 mm longus. Corolla statu alabastri adulti c. 18 ad 19 mm longa, in 15 mm inferioribus fusiformiter inflata, basi c. 1 mm medio 3 ad 4 mm lata, supra inflationem in partam apicalem prismaticam 5-angulam 4 mm longam, 2 ad 2.5 mm latam transiens, apice rotundata, a c. 1 mm supra basin usque ad apicem carinis 5 acutis dimidia longitudine alas 5 angustas formentibus (ut in Macrosolene), postea dehiscens usque ad 11 mm supra basin in lacinias 5 subacutas 3 ad 3.5 mm ab apice reflexas. Filamenti pars libera 2 mm longa; anthera oblonga, c. 3 mm lata, obtusa, loculis 4 continuis. Stylus corollae aequilongus, a basi tenuissima ad apicem sensim incrassatus, sub stigmate c. 0.4 mm crassus; stigma subglobosum, obtusissimum. Cetera ignota.

This peculiar species differs from all *Dendrophthoe* known to me by the style gradually thickened from the base to the top, the 5-alate flower buds, and the campanulate calyx with entire, short limb. Also the 2-flowered inflorescences are remarkable and show a resemblance to *Amyema* or *Taxillus*, but the peduncle, often somewhat prolonged above the flowers, shows that the inflorescence is a reduced raceme, and the 5-merous regular corolla shows, moreover, that this species is not a *Taxillus*.

BASILAN, Komalarang, *Bur. Sci. 16160 Reillo* (M).

### XI. Genus SCURRULA Linnæus

*Scurrula* LINN., Sp. Pl. ed. 1 1 (1753) 110; Gen. Pl. ed. 5 (1754) 48; G. DON., Gen. Hist. Dichl. Pl. 3 (1834) 402, 421; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 292, 349, 356, 358, 367; 11 (1931) 236, 427; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 5, 101.

*Etubila* RAFIN., Sylva Tell. (1838) 125.
*Antriba* RAFIN., Sylva Tell. (1838) 126.
*Cichlanthus* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 243, 253, 270, 271.

Inflorescentia racemosa, floribus bractea singula suffultis. Corolla sympetala, 4-meres, zygomorpha, statu alabastri adulti parte inferiore inflata, parte media angustata, parte apicali clavata, apice decurvata, postea latere inferiore multo profundius partita quam inter alias lacinias, laciniis omnibus sursum reflexis, spathulatis, crassiusculis, acutis. Antherae basifixae, obtusae, 4-loculares. Stylus corollae aequilongus. Fructus clavatus, parte superiore crassa semen continente, exocarpio coriaceo, mesocarpio viscoso, endocarpio infundibuliformi, quadriangulo, lignoso, basi in stipitem lignosum prolongato.

The genus *Scurrula* is spread all over the Philippines. Outside the Philippine Archipelago it is found in the southeastern part of the Asiatic Continent and the western half of the Malay Archipelago, with its eastern limit in Borneo and Timor.

It is remarkable that in the Philippines *Scurrula* is much commoner in Luzon than in the southern islands; in Negros and Panay it has not been collected at all, and from Mindanao I have seen only two numbers. Perhaps we may partly ascribe this to the circumstance that *Scurrulæ* prefer open, cultivated regions, with the many fruit trees of the native villages, to those covered with tropical forests.

All of the species of *Scurrula* are distinguished with difficulty, and sharp species limits appear to exist nowhere. On the other hand, it is impossible to suppose that all *Scurrulæ* might be forms of a single species. Among the Philippine *Scurrulæ* I could distinguish not more than three species, but I must confess, that the species limits, accepted by me, do not satisfy me much.

*Key to the Philippine species of Scurrula.*

1. Large-leaved, long-flowered, with light-colored tomentum; leaves usually 4 to 9 cm long, 2.5 to 6 cm broad, roundly-elliptical to oblong; corolla and style 15 to 25 mm long........................................ 3. *S. philippensis.*
   Large-leaved, short-flowered, with ferrugineous tomentum; leaves rounded-elliptical to oblong, 4 to 9 cm long, 1.5 to 4 cm broad; corolla and style about 10 mm long........................................ 2. *S. ferruginea.*
   Small-leaved, small-flowered; leaves usually rounded- to lanceolate-obovate, 1.5 to 6 cm long, 1 to 3 cm broad; corolla and style usually 9 to 15 mm long, rarely longer........................................ 1. *S. parasitica.*

1. **SCURRULA PARASITICA Linnæus.**

*Scurrula parasitica* LINN., Sp., Pl. ed. 1 **1** (1753) 110; DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 352; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 **29** 6 (1933) 104.

*Loranthus Scurrula* LINN., Sp. Pl. ed. 2 **1** (1762) 472.

*Loranthus buddleioides* DESR., in Lam., Encycl. Méth. Bot. **3** (1789) 600.

*Loranthus fuscus* BL., Verh. Bot. Genootsch. **9** (1823) 192; FER.-VILL., Nov. App. (1880) 184; MERR., Enum. Philip. Fl. Pl. **2** (1923) 111.

*Loranthus atropurpureus* var. *cuneatus* BL., Bijdr. **13** (1825) 660.

*Loranthus gracilifolius* SCHULT., Syst. **7** 1 (1829) 99.

*Loranthus cinnamomeous* DC., Mém. Lor. (1830) 27, t. 6.

*Loranthus obtectus, graciliflorus, Heynei, sphaeroideus, laevigatus, rufidulus* DC., Prodr. **4** (1930) 299–302.

*Dendrophthoe gracilifolius* MART., Flora **1** (1830) 110.

*Dendrophthoe gracilifolius* MART., in Schult., Syst. **7** 2 (1830) 1614.

*Loranthus sphenoideus* BL., in Schult., Syst. **7** 2 (1830) 1612, 1730; FER.-VILL., Nov. App. (1880) 183; VIDAL, Pl. Cuming. Philip. (1885) 6, 77, 140; Rev. Pl. Vasc. Filip. (1886) 231; MERR., Philip. Journ. Sci. § C **4** (1909) 139; Enum. Philip. Fl. Pl. **2** (1923) 110.

*Loranthus Heyneanus* SCHULT., Syst. **7** 2 (1830) 1650 nom. nud.

*Loranthus Roxburghianus* BL., in Schult., Syst. **7** 2 (1830) 1730.

*Dendrophthoe obtectus, Heynei, cinnamomeus, sphenoides, Scurrula, Roxburghii, budleioides, laevigata, rufidula* G. DON, Gen. Hist. Dichl. Pl. **3** (1834) 420–422.

*Scurrula fusca* G. DON, Gen. Hist. Dichl. Pl. **3** (1934) 421; DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 350; **11** (1931) 434; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 **29** 6 (1933) 102.

*Antriba budleioides* RAFIN., Sylva Tell. (1838) 126.

*Loranthus fulvus* and *fuscatus* KORTH., Verh. Bat. Genootsch. **17** (1839) 273.

*Loranthus concavifolius* GRIFF., Not. Pl. As. **4** (1854) 615.

*Dendrophthoe repanda* var. *sphaeroidea, Dendrophthoe fusca, fulva, fuscata* MIQ., Fl. Ind. Bat. **1** 1 (1856) 812–815.

*Dendrophthoe ignea* SCHEFF., Nat. Tijdschr. Ned. Ind. **31** (1870) 357.

*Loranthus igneus* BENTH. and HOOK. F., Gen. Pl. **3** (1880) 209.

*Loranthus malaccensis* HOOK. F., Fl. Br. Ind. **5** (1886) 210.

*Cichlanthus Scurrula* and *fuscus* VAN TIEGH., Bull. Soc. Bot. Fr. **42** (1895) 253.

*Loranthus confusus* and *similis* MERR., Philip. Journ. Sci. § C **7** (1912) 261, 262; Enum. Philip. Fl. Pl. **2** (1923) 103, 110.

*Loranthus parasiticus* MERR., Philip. Journ. Sci. **15** (1919) 232; Enum. Philip. Fl. Pl. **2** (1923) 108.

*Scurrula ignea* DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 351.

*Scurrula similis* DANS., Bull. Jard. Bot. Buitenzorg III **10** (1929) 353; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 **29** 6 (1933) 105.

For further literature about these synonyms cfr. HOOKER F., Fl. Br. Ind. 5: 208; DANS., Bull. Jard. Bot. Buitenzorg III 11: 434.

Omnes partes juveniles tomento e pilis ramosis composito, nunquam longo vel floccoso, albo vel cano vel ochraceo vel fusco, vestito, folia facie superiore mox glabrescentia, inferiore etiam glabrescentia vel tomento magis vel minus permanente, inflorescentiae tomento permanente sed in partibus excrescentibus tenuescente. Internodia folia adulta ferentia longitudine valde variabilis, 1 ad 2 mm crassa. Petiolus basi teres, laminam versus supra applanatus vel sulcatus, plerumque 3 ad 10 mm longus, 0.3 ad 1.25 mm crassus; lamina rotundato-elliptica ad oblonga vel obovata ad lanceolato-obovata, plerumque 1.5 ad 6 cm longa, 1 ad 3 cm lata, raro major, basi vulgo cuneata rarius rotundata, apice plerumque rotundata vel obtusa, rarius acutiuscula. Inflorescentiae plerumque 2 ad 4 florae; axis plerumque brevis, 0 ad 4 raro ad 6 mm longus; pedicelli 1 ad 3 mm longi; bracteae 1 ad 2 mm longae, suborbiculares ad oblongae. Calicis campanulato-infundibuliformis vel nonnihil piriformis, 2 ad 2.5 mm longus, 0.75 ad 1 mm latus, limbo plerumque nullo, rarius indistincto ad 0.5 mm longo. Corolla 9 ad 15 mm longa, rarius longior, tubo 1.5 ad 2.5 mm lato, basi rotundato, limbum versus attenuato, laciniis parte reflexa 3 ad 4 mm longis, acutiusculis vel acutis. Filamenti pars libera 1 ad 2 mm longa; anthera 1 ad 1.5 mm longa. Fructus claviformis, apice rotundatus, basin versis plerumque sensim attenuatus, 9 ad 11 mm longus, 2.5 ad 3.5 mm crassus.

*Scurrula parasitica* is spread all over the Philippines from sea level to 2,300 m elevation.

Formerly, I treated *S. parasitica* and *S. fusca* as separate species, but further studies proved that these two can as little be kept apart as several others that already had been taken together by Hooker under *Loranthus scurrula* and by me under *S. fusca.* The *S. parasitica* we get this way is certainly very polymorphic, but provisorily this conception seems more correct than describing the most striking local forms as different species and neglecting the numerous intermediate ones. Perhaps a monographic study of *Scurrula* will throw more light upon the species limits in this genus.

*Loranthus confusus* Merr. is certainly a striking form, typical for Luzon, with small, narrowly obovate leaves, whitish or grayish tomentum and corolla, and style nearly 10 mm long. South

of Luzon there occur forms with larger leaves and longer flowers that cannot be separated from it. *Loranthus similis* is one of these forms and even not a typical one. Merrill describes the corolla as 18 mm long, but the type has the corollas 13 to 14 mm long. Similar forms with longer flowers are, however, not rare in the islands south of Luzon.

Philippines, without exact locality, *Cuming 1970* (L, partly, cfr. *Taxillus estipitatus*) *490* (M, Be), *1959* (M, type of *Loranthus confusus* Merr.). LUZON, Ilocos Norte Province, Burgos, 18 m altitude, *Bur. Sci. 27202 Ramos* (M) ; Bangui *Bur. Sci. 4352 McGregor* (M, UC, B, Be) ; Santa Maria, Barrio Lungog, summit of Magei Hill, *Clemens 17855* (UC) : La Union Province, Bauang, *Elmer 5711* (M), *Fénix 119* (M), *Bur. Sci. 12951, Fénix* (M, B, L, Be) : Mountain Province, Bontoc, Gaddac, Ginsadan, 1,300 m altitude, *Vanoverbergh 402* and *403* (M) ; Lepanto, *Comisión de la Flora Forestal de Filipinas 1693* (L) ; Benguet Subprovince, Susod, 700 m altitude, *F. B. 10903 Curran* (M) ; Sablan, *Williams 1379* (M, NY) ; Baguio, *Elmer 8735* (NY, B, L) ; *F. B. 4880 Curran* (M, Be) ; *Williams 983* (NY), *Williams 984* (M, type, NY, cotype of *Loranthus similis* Merr.) ; Mount Pauai, 2,300 m altitude, *Bur. Sci. 82366 Quisumbing and Sulit* (M) : Pangasinan Province, "Busquis de Bani," *Bur. Sci. 4977 Ramos* (M) ; Bayambang, *Merrill 66* (M) ; San Quintin, *Octubre 5671* (M) ; Siblong, Villasis, *Alberto 35* (M) ; Mount San Isidro, Labrador, 200 m altitude, *Bur. Sci. 29929 Fénix* (M, B, L) : Zambales Province, Silanguin, *F. B. 5928 Curran* (M, Be) ; Santa Fe, 90 m altitude, *F. B. 29536 Antonio* (UC, M, B) ; Pombato, *Gates and Feria 8153* (M) ; Anuling, Iba, low altitude, *Bur. Sci. 44575 Ramos and Edaño* (M, NY, UC, B, S) : Bulacan, Norzagaray, *Yoder 201* (M) ; Angat, low altitude, *Bur. Sci. 34196 Ramos and Edaño* (M) : Bataan Province, Limay, 10 m altitude, *Bur. Sci. 9612 C. B. Robinson* (M, NY, B, L, Be) : Rizal Province, trail to Bosoboso, *Bur. Sci. 110 Foxworthy* (M, NY, B, Be) ; San Andales, *Bur. Sci. 19252 Reillo* (M, NY, UC, B) ; Puro, 300 m altitude, *Bur. Sci. 24071 Ramos* (M, B, L) ; Morong, *Loher 4470* (Be) ; Pantay, *Ramos 254* (M, U, Br) : Tayabas Province, Lucena, sea level, *Whitford 590* (M) : Camarines Province, Mount Isarog, 60 m altitude, *Bur. Sci. 22078 Ramos* (M) ; Sorsogon Province, Mount Bulusan, Irosin, *Elmer 15252* (M, UC, B, L, U). ALABAT, low altitude, *Bur. Sci. 48094 Ramos and Edaño* (M, NY, UC). MINDORO, Tubili, 2 m altitude, *F. B. 8792 Merritt* (M) ; Puerto

Galera, Baco, 0 m altitude, *Bur. Sci. 15289 Kienholz* (M, UC, NY). MARINDUQUE, *Comisión de la Flora Forestal de Filipinas 1695* (L). ROMBLON, *Elmer 12158* (NY, B, L, U, Be). SIBUYAN, *Elmer s. n. ?* (M). TICAO, on beach, *F. B. 2532 W. W. Clark* (M, NY, Be). SAMAR, Loquilocon, 250 m altitude, *Bur. Sci. 43724 McGregor* (M, NY, UC, S, B). BILIRAN, mangrove-swamp tree, *Bur. Sci. 18589 McGregor* (M). LEYTE, Jaro, Buenavista, 500 m altitude, *Wenzel 973* (M) ; Mount Abucayan, low altitude, *Bur. Sci. 41733 Edaño* (M, B, S, L, Be). GUIMARAS, Nagaba, 100 m altitude, *F. B. 249 Gammill* (M, NY, Be). CEBU, Cebu, *Bur. Sci. 11038 Ramos* (M, Be). BOHOL, Bilar, 600 m altitude, *Bur. Sci. 42693 Ramos* (M, UC) ; Dimiao, 300 m altitude, *Bur. Sci. 42685 Ramos* (M, B, Be). MINDANAO, Lanao Province, Lake Lanao, Camp Keithley, *Clemens s. n.* (M), *Clemens 459* (M, B, Be) : Davao Province, Davao, *Williams 3062* (NY). CULION, *Herre 1006* (NY). PALAWAN, Taytay, 3 to 4 m altitude, *Merrill 9262* (M, NY, B, L).

Further distribution, the same as that of the genus.

**2. SCURRULA PHILIPPENSIS (Chamisso and Schlechter) G. Don.**

*Loranthus philippensis* CHAM. and SCHLECHT., Linnaea 3 (1828) 204; DC., Prodr. 4 (1830) 302; SCHULT., Syst. 7 2 (1830) 1633; BLUME, in Schult., Syst. 7 2 (1830) 1730; Fl. Javae (1830) 14; DIETR., Synopsis 2 (1840) 1075; ASA GRAY, U. S. Explor. Exped. 1 (1854) 741; FER.-VILL., Nov. App. (1880) 183; VIDAL, Rev. Pl. Vasc. Fil. (1886) 231; ENGL., in Engl. and Pr., Nat. Pfl. fam. 3 1 (1889) 188; MERR., Philip. Journ. Sci. § C 3 (1908) 84; 4 (1909) 139; LECOMTE, Not. Syst. 3 (1914) 166; in Sargent, Pl. Wilson. 3 (1916) 317; MERR., Sp. Blanco. (1918) 131; Enum. Philip. Fl. Pl. 2 (1923) 108; SULIT, Philip. Agr. 19 (1931) 665–673.

*Scurrula philippensis* G. DON, Gen. Hist. Dichl. Pl. 3 (1834) 442; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 352; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 104.

*Lonicera Symphoricarpos* BLANCO, Fl. Fil. ed. 1 (1837) 161.

*Loranthus pauciflorus* BLANCO, Fl. Filip. ed. 1 (1837) 235.

*Loranthus Junghuhnii* MOLKENB., in Miq., Pl. Jungh. (1852) 113; BOERL., Handl. Fl. Ned. Ind. 3 1 (1900) 164; KOERNICKE, Ann. Jard. Bot. Buitenzorg Suppl. 3 2 (1910) 677; KOORDERS, Exkursionsfl. 2 (1912) 161.

*Dendrophthoe philippensis* and *Junghuhnii* MIQ., Fl. Ind. Bat. 1 1 (1856) 817.

*Loranthus philippinensis* BENTH. and HOOK. F., Gen. Pl. 3 (1880) 209; VIDAL, Pl. Cuming Philip. (1885) 6, 78, 140.

*Cichlanthus philippensis* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 253.

*Scurrula Junghuhnii* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 351; 11 (1931) 437; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 103.

*Scurrula philippinensis* DANS., Bull. Jard. Bot. Buitenzorg III 11 (1931) 466.

Omnes partes juveniles tomento e pilis ramosis composito plerumque albido nonnunquam flavido vel subfusco dense vestitae, ramulis et foliorum paginis superioribus mox glabrescentibus, foliorum paginis inferioribus denique parce pilosis vel glabris, inflorescentiis tomento permanente, in partibus excrescentibus (ut corolla) tenuescente. Internodia folia adulta ferentia plerumque 3 ad 4 cm longa, 2 ad 4 mm crassa. Petiolus teres vel supra leviter sulcatus, plerumque 3 ad 10 mm longus, 1 ad 1.5 mm crassus; lamina rotundato-elliptica vel elliptica vel oblonga, basi cuneata vel rotundata vel leviter cordata, apice obtusa vel rotundata, tenuiter coriacea, opaca vel supra sublucida, 4 ad 9 cm longa, 2.5 ad 6 cm lata. Inflorescentiae plerumque 2 ad 8-florae; axis ad 12 mm longus; pedicelli plerumque 2 ad 4 mm longi; bracteae ellipticae, concave, 1 ad 1.5 mm longae, obtusae. Calicis tubus obovato-campanulatus, c. 3.5 mm longus, limbus erectus vel subinfundibuliformis, ad 0.5 mm longus, integer vel leviter obtuseque 4-dentatus. Corolla plerumque 15 ad 25 mm longa, tubo e basi rotundata ad 3 mm lata sensim attenuato, partibus laciniarum reflexis anguste lanceolatis acutissimis; anthera 1.5 ad 3 mm longa. Stylus c. 3 mm ab apice undulatus. Fructus clavatus, ad 10 mm longus, ad 3.5 mm crassus, sub apice rotundato sensim attenuatus, plerumque calicis limbo coronatus.

In the Philippines *S. philippensis* is restricted to Luzon, where it occurs from sea level to 2,300 m altitude. It appears, however, impossible to keep it separated from the Javan *Scurrula Junghuhnii,* though there are small differences. *Scurrula philippensis* has a whitish tomentum, and the corolla is often longer and with more acute lobes, whereas *S. Junghuhnii* has a yellowish or even brownish tomentum and more obtuse corolla lobes. The type of *S. philippensis* is rather short-flowered (corolla and style nearly 15 mm long), but for the remainder it is quite typical.

Philippines, without exact locality, *A. von Chamisso* (Be, type of *Loranthus philippensis* Cham. and Schlecht.), *Cuming 491* (M, L, Be), *Cuming 1977* (M). LUZON, Mountain Prov-

ince, Benguet, Sablang, *Bur. Sci. 12728 Fénix* (M, B, L) ; Pauai, 2,300 m altitude, *Bur. Sci. 31676 Santos* (M, NY, S, L) ; Baguio, *Elmer 8873* (NY, B, L) : Cagayan Province, Tuao, *Bur. Sci. 7865 Ramos* (M) : Isabela Province, San Mariano, 300 m altitude, *Bur. Sci. 47060 Ramos and Edaño* (M, UC, NY, S) : Nueva Vizcaya Province, Bambang, *F. B. 15783 Curran and Merritt* (M, Be) : Pangasinan Province, *Otanes s. n.* (U) ; *Bur. Sci. 4972 Ramos* (M, NY) ; Labrador, 25 m altitude, *Bur. Sci. 30028 Fénix* (M, B, L) : Zambales Province, Anuling, low altitude, *Bur. Sci. 44634 Ramos and Edaño* (M, UC, NY, B) : Pampanga Province, Arayat, *Warburg 13328* (Be) : Bataan Province, *F. B. 5790 Curran* (M) ; Dinalupihan, *Merrill 1585* (M) : Bulacan Province, *Bur. Sci. 22414 Ramos* (M) ; Norzagaray, *Yoder 241* (M) : Rizal Province, Bosoboso, *F. B. 3169 Ahern's coll.* (M, NY, B, S) ; Antipolo, *Merrill 1688* (M, Be) ; Merrill, *Sp. Blancoanae 322* (NY, B, Be, L) ; 700 m altitude, *Bur. Sci. 128 Foxworthy* (M, NY, Be) ; Munang, *Bur. Sci. 10881 Ramos* (M, B, L, Be) ; San Andales, *Bur. Sci. 19285 Reillo* (M, S) ; Mayatagan River, low altitude, *Bur. Sci. 48763 Edaño* (M, UC, NY) ; Montalban, *Loher 4472* (Be) ; *Elmer 12577* (M, NY, B, L, U) : Laguna Province, Los Baños, *Baker 999* (M), *Elmer 17918* (M, UC, B, L, U), *Hallier s. n.* (M) ; College Campus, 75 m altitude, *F. B. 26452 Nano* (M) ; Lilio, *Bur. Sci. 6013 C. B. Robinson* (M, NY), *De Leon 4074* (M) ; Calauan, *McGregor 484* (M, U, Br) : Batangas Province, Santo Tomas, *Aurelia Malvar 316* (M) : Tayabas Province, Casiguran, low altitude, *Bur. Sci. 45370 Ramos and Edaño* (M, NY, UC, B).

Further distribution: Java.

**3. SCURRULA FERRUGINEA (Jack) Danser.**

*Loranthus ferrugineus* JACK, Malay Misc. 1 (1820) 279, t. 59; MERR., Philip. Journ. Sci. § C 4 (1909) 140; Enum. Philip. Fl. Pl. 2 (1923) 104.

*Loranthus chrysanthus* DC., Prodr. 4 (1830) 300.

*Loranthus ferruginosus* ROXB., Fl. Ind. ed. 2 2 (1832) 188.

*Dendrophthoe ferrugineous* and *chrysanthus* G. DON, Gen. Hist. Dichl. Pl. 3 (1834) 420.

*Etubila ferruginea* RAFIN., Sylva Tell. (1838) 159.

*Loranthus chrysanthoides* KORTH., Verh. Bat. Genootsch. 17 (1839) 227, 269.

*Dendrophthoe chrysanthoides* MIQ., Fl. Ind. Bat. 1 1 (1856) 813.

*Cichlanthus ferrugineus* and *chrysanthus* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 253.

*Scurrula chrysanthoides* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 350.

*Scurrula ferruginea* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 350; 11 (1931) 432; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 102.

Omnes partes juveniles tomento denso floccoso ferrugineo vestitae, foliorum pagina superiore mox glabrescente, pagina inferiore tomento tenuescente, inflorescentiis tomento permanente sed in partibus excrescentibus paulum tenuescente. Internodia folia adulta ferentia 0 ad 5 cm longa, 1 ad 3 mm crassa. Petiolus plerumque 2 ad 9 mm longus, 0.5 ad 1 mm crassus, teres, supra paulum applanatus, laminam versus canaliculatus; lamina circiter oblonga, saepe paulum ovata vel obovata, plerumque 4 ad 9 cm longa, 1.5 ad 4 cm lata, basi rotundata vel leviter cordata, apice obtusa vel rotundata, tenuiter coriacea, opaca. Inflorescentiae plerumque 2- ad 5-florae; axis 0 ad 3 mm longus raro longior; pedicelli plerumque 1 ad 3 mm longi; bracteae ovatae vel oblongae, 1 ad 2 mm longae, obtusae, naviculatae. Calicis tubus ovatus, 2.5 ad 3.5 mm longus, 2 ad 2.5 mm latus; limbus erectus, c. 0.5 mm longus, integer. Corolla c. 10 mm longa, crassiuscula, haud gracilis, paulum tantum curvata, lobis paulum spathulatis obtusis. Filamenti pars libera c. 1.5 mm longa. Anthera 0.75 ad 1 mm longa. Stylus ad c. 1 mm ab apice undulatus. Fructus clavatus, e parte superiore globosa vel breve ellipsoides, 3 ad 4 mm crassa, basin versus subabrupte attenuatus, 10 ad 12 mm longus.

The above description is based on the Palawan specimens only. They represent the form described from Borneo by Korthals under the name *Loranthus chrysanthoides*. In the Philippines *S. ferruginea* does not occur in other islands. Outside of the Philippines it is widely spread in the southeastern part of the Asiatic Continent and in the western part of the Malay Archipelago.

PALAWAN, *Bur. Sci. 15534 Fénix* (L); Puerto Princesa, *Bur. Sci. 203* (M, NY, B, Be), *Bur. Sci. 45950 McGregor* (M, UC, NY, B); Mount Pulgar, *Elmer 12905* (M, NY, B, L, U); Iwahig River, *Merrill 705* (M, NY, Be); Iwahig, *Bur. Sci. 823 Foxworthy* (M, NY, B, Be); Banalingajan River, 300 m altitude, *Bur. Sci. 77412 Edaño* (M); Mount Kabangaan, 300 m altitude, *Bur. Sci. 77733 Edaño* (M); 450 m altitude, *Bur. Sci. 77693 Edaño* (M).

### XII. Genus TAXILLUS Van Tieghem

*Taxillus* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 243, 256, 270, 271; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 292, 354, 367; 11 (1931) 236, 444; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 123.

*Phyllodesmis* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 243, 255, 270, 271; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 349.

*Bakerella, Locella, Septulina* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 242, 244, 261, 263, 270, 271.

Inflorescentia umbellata, floribus bractea singulae suffultis. Corolla sympetala, 4 vel 5 meres, zygomorpha, statu alabastri adulti parte inferiore inflata, parte media augustata, parte apicali clavata, apice decurvata, postea latere inferiore profundius partita quam inter alias lacinias, laciniis omnibus sursum reflexis. Antherae basifixae, 4-loculares. Stylus exarticulatus. Fructus ovoides vel ellipsoides, exocarpio coriaceo, mesocarpio viscoso, endocarpio sub semine in cupulan lignosam indurato.

The genus *Taxillus* is spread in southeastern Asia, in the archipelagoes from Ceylon to Madagascar, and in South Africa. In the Malay Archipelago it is represented by one species, which is restricted to the Philippines and North Borneo.

**1. TAXILLUS ESTIPITATUS** (Stapf) Danser.

*Loranthus estipitatus* STAPF, Trans. Linn. Soc. II Bot. 4 (1894) 221; FORB. and HEMSL., Journ. Linn. Soc. Bot. 26 (1894) 405; BOERL., Handl. Fl. Ned. Ind. 3 1 (1900) 164; MERR., Philip. Journ. Sci. § C 4 (1909) 139; DUNN and TUTCHER, Kew Bull. Add. Ser. 10 (1912) 229; GAMBLE, Journ. As. Soc. Beng. 75 2 (1914) 362; LECOMTE, Not. Syst. 3 (1914) 72, 174; Fl. Indo-China 5 (1915) 193; in Sarg., Pl. Wilson. 3 (1916) 316; MERR., Journ. Str. Br. Roy. As. Soc. Special No. 1921 (1921) 237; RIDL., Fl. Mal. Pen. 3 (1924) 154; MERR., Philip. Journ. Sci. 29 (1926) 366.

*Taxillus estipitatus* DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 355; 11 (1931) 445; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 124.

Omnes partes juveniles tomento tenui sed denso, in ramulis foliisque mox deciduo, in inflorescentiis floribusque diu permanente denique deciduo. Ramuli graciles ramosissimi, teretes, nodis incrassatis, internodiis folia adulta ferentibus plerumque 1.5 ad 3.5 mm longis, 0.5 ad 2 mm crassis. Folia opposita vel rarius subopposita; petiolus subtus rotundatus, supra a basi ad laminam sensim applanatus, tota longitudine leviter sulcatus; lamina rotundato-elliptica vel elliptica, saepe paulum ovata, rarius obovata, 1.5 ad 5 cm longa, 1 ad 3 cm lata, basi rotundata vel cuneata, rarius in petiolum contracta, apice obtusa vel rotundata, tenuiter coriacea vel chartacea, utraque facie opaca vel superiore sublucida, facie superiore nervis omnibus distinctis, inferiore costa valde nervis ceteris minus prominentibus. Inflorescentiae singulae in axillis foliorum, rarius gregatim in nodis defoliatis, plerumque 2-flori rarius 3-flori; pedunculus 2 ad 4 mm longus, 0.25 ad 0.5 mm crassus, teres, apice paululum incrassatus; pedicelli 4 ad 9 mm longi, pedunculo aequicrassi vel apicem versus paulo crassiores, teretes; bracteae rotundato-ovatae, 0.5 ad 1 mm longae, obtusae, crassiusculae. Calicis tubus globoso-ellipsoides vel subobovatus, c. 1.75 mm longus, 1.5 mm latus, superficie iam tempore florendi verrucosa; limbus brevissimus minus quam 0.25 mm longus, erectus vel subinfundibuliformis, integer, a tubo valde diversus. Corolla 16 ad 21 mm longa, statu alabastri adulti supra basin rotundatam 2 ad 2.5 mm lata, deinde usque ad 3 ad 4 mm ab apice sensim ad 0.75 ad 1 mm attenuata, denique in clavam obovatam c. 1.75 mm crassam apice rotundatam incrassata, postea partita in lacinias 4, incisionibus 3 usque ad 3 quartas vel 2 quintas longitudinis percurrentibus, quarta profundiore nonnunquam fere ad basin percurrente, laciniis spathuliformis, 2 ad 2.5 mm longus, c. 0.8 mm latis, crassiusculis, obtusis. Filamenti pars libera 0.25 ad 0.5 mm longa; anthera oblonga, 1 ad 2 mm longa, apice obtusissima, loculis 4 indistincte locellatis. Stylus corollae aequilongus, apicem versus paulum attenuatus, sulcis 4; stigma subglobosum, styli apice c. sesquiplo crassius. Fructus ellipsoides, basi apiceque rotundatus, ad 8 mm longus, 4.5 mm crassus, tota superficie verrucosa (omnino maturus forte levis?) calicis limbo erecto paulum aucto coronatus.

Philippines, without exact locality, *Cuming 1970* (M, wholly, L, partly). LUZON, Tayabas Province, Malbog, 80 m altitude, *F. B. 30695 Oro* (M, NY); Lucban, *Elmer 7513* (B, L) and *7911* (M, NY, B, L): Bataan Province, Bataan, *Comisión de la flora forestal de Filipinas 516* (L): Rizal Province, Mount Kanumay, *Ramos 1020* (M, U, Br, BM); Mount Lumutan, 600 m altitude, *Bur. Sci. 42166 Ramos* (M, S); Bosoboso, *Merrill 1826* (M): Laguna Province, Lilio, *De Leon 4073* (M); Capugan, *Bur. Sci. 13517 Ramos* (M, B, L, Br); trail, Paete to San Antonio, *Bur. Sci. 16526 Ramos* (M, G, Br); Paete, *Bur. Sci. 22892 McGregor* (M, B, S, L); Mount Maquiling, *Foxworthy s. n.* (M); Los Baños, *Elmer 17546* (M, UC, B, L, U). SIBUYAN,

Capiz Province, Mount Giting-giting, Magallanes, *Elmer 12125* (M, NY, B, L, U). NEGROS, Oriental Negros Province, Cuernos Mountains, Dumaguete, *Elmer 10105* (NY, B, L). PALAWAN, Taytay, sea level, *Merrill 9396* (M, NY, B, S, L).

### XIII. Genus PHRYGILANTHUS Eichler

*Phrygilanthus* EICHL., in Mart., Fl. Brasil. 5 2 (1868) 22, 45; ENGL., in Engl. and Pr., Nat. Pfl. fam. 3 1 (1889) 178; VAN TIEGH., Bull. Soc. Bot. Fr. 41 (1894) 143; ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 133; MERR., Philip. Journ. Sci. § C 4 (1909) 151; KRAUSE, in Engl. Jahrb. 57 (1922) 491; BLAKELY, Proc. Linn. Soc. N. S. Wales 47 (1922) 206; MERR., Enum. Philip. Fl. Pl. 2 (1923) 112; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 292, 348; 11 (1931) 446; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 99.

*Müllerina, Hookerella, Furcilla* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 25, 26, 85, 87, 162, 163, 166, 175, 179.

Inflorescentia cymosa, simplex vel composita, vel racemus cymarum, floribus singula bractea suffultis. Corolla choripetala. Antherae dorsifixae.

The genus *Phrygilanthus* is chiefly American; there is a small number of species in eastern Australia, one in New Guinea, and one in the Philippines. Probably the Philippine and the New Guinea species are identical.

#### 1. PHRYGILANTHUS OBTUSIFOLIUS Merrill.

*Phrygilanthus obtusifolius* MERR., Philip. Journ. Sci. 1 Suppl. (1906) 189; § C 4 (1909) 151; Enum. Philip. Fl. Pl. 2 (1923) 112; DANS., Bull. Jard. Bot. Buitenzorg III 10 (1929) 349; Verh. Kon. Akad. Wetensch. Amsterdam afd. Natuurk. § 2 29 6 (1933) 99.

Omnis glabra. Ramuli ramosissimi, teretes, nodis incrassatis, internodiis valde juvenilibus apicem versus applanatis, folia adulta ferentibus 1 ad 3 mm longis, 0.75 ad 1.25 mm crassis. Folia opposita, cuneato-obovata, 2.5 ad 7 cm longa, 0.8 ad 2.5 cm lata, basi cuneatim angustata et in partem petioliformen 2 ad 6 mm longam attenuata, crassiuscule coriacea, faciebus subsimilibus, utraque facie opaca vel nonnihil lucida, flabellinervis, costa et 2 paribus nervorum lateralium longitudinalibus prope basin visibilibus, venis omnino invisibilibus. Inflorescentiae 2-florae, plerumque singulae in axillis foliorum (etiam terminalium), et gregatim in nodis defoliatis, nonnunquam etiam inflorescentia terminalis floribus brevissime pedicellatis; pedunculus teres, basi apiceque paulum incrassatus, 2 ad 10 mm longus, c. 0.5 mm crassus; pedicelli teretes, 0 ad 3 mm vel post anthesin

ad 4 mm longi, pedunculo fere aequicrassi; bracteae suborbiculares, 0.5 mm longae. Calicis tubus campanulatus vel nonnihil urceolatus, c. 1.5 mm longus bene 1 m latus; limbus infundibuliformis, integer, c. 0.4 mm longus. Corolla statu alabastri adulti clavata, 5-angula (raro 4-angula), c. 11 mm longa, supra basin 2 mm latam coniformiter angustata in partem mediam c. 0.75 mm latam, in 3 superioribus ellipsoides, c. 1.25 mm crassa, apice obtusissima; postea dehiscens in petala 5 (nonnunquam 4) parte inferiore facie interiore carina mediana, supra eam partem dente obtuso in constrictionem styli quadrante, deinde (in parte angustissima) filamento adnato prominente usque ad 4 mm supra basin, deinde concava spathulata, apice obtusa, supra insertionem filamenti recurvata apice incurvata. Filamenti pars libera c. 4 mm longa, apice acuta; anthera c. 1.5 mm longa, 0.75 mm lata, basi apiceque obtusissima, loculis 4 continuis, medio vel paulum sub medio affixa. Stylus acute 5- (raro 4-) angulus, lateribus cavis, a basi usque ad mediam longitudinem sensim attenuatus, c. 2 mm supra basin magis minusve (nonnunquam valde) constrictus, ad c. 2.5 mm a stigmate iterum (sed minus) constrictus; stigma styli apice paulo crassius, obtusissimum. Fructus globoso-ellipsoides vel paulum obovoides, levis, ad 6 mm longus ad 5 mm crassus, calicis limbo patente coronatus, endocarpio sub semine in cupulam lignosam indurato.

LUZON, Ilocos Norte Province, Burgos, low altitude, *Bur. Sci. 32837 Ramos* (M, NY, S): Bataan Province, Mount Mariveles, Lamao River, *Whitford 1081* (NY, Be); 600 m altitude, *Whitford 134* (M, NY, B, S); 650 m altitude, *F. B. 1813 Borden* (M, type, NY, B, S, Be, cotypes), fruit dark yellow or bright red; Lamao Forest Reserve, *F. B. 6286 Curran* (M, NY, Be), flower greenish white or flushed lemon yellow, slightly fragrant. MINDANAO, Agusan Province, Mount Urdaneta, Cabadbaran, *Elmer 14192* (M, NY, UC, B, U).

### XIV. Genus GINALLOA Korthals

*Ginalloa* KORTH., Verh. Bat. Genootsch. 17 (1839) 260; ENDL., Gen. Pl. (1840) 1415; WALP., Repert. 2 (1843) 439; MIQ., Fl. Ind. Bat. 1 1 (1856) 807; BAILL., Adansonia 3 (1862) 106; OLIV., Journ. Linn. Soc. Bot. 7 (1864) 92; KURZ, For. Fl. Burma 2 (1877) 326; BENTH. and HOOK. F., Gen. Pl. 3 (1880) 215; HOOK. F., Fl. Br. Ind. 5 (1886) 228; ENGL., in Engl. and Pr., Nat. Pfl. fam. 3 1 (1889) 192; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 473; VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 646; 43 (1896) 162; ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 139; BOERL., Handl. Pl. Ned. Ind. 3 1 (1900) 156, 160; MERR., Philip. Journ. Sci. § C 4 (1909) 130, 153; KOORD., Exkursionsfl. 2 (1912) 166; GAMBLE,

Journ. As. Soc. Beng. 75 (1914) 383; LECOMTE, Fl. Indo-China 5 (1915) (1915) 206; MERR., Enum. Philip. Fl. Pl. 2 (1923) 112; RIDL., Fl. Mal. Pen. 3 (1924) 163; DANS., Bull. Jard. Bot. Buitenzorg III 11 (1931) 448.

Inflorescentiae axillares spicatae, articulatae, bracteis decussatis, principio florem singulum femineum, postea etiam flores 2 masculos laterales, denique nonnunquam flores additionales ferentibus. Flos masculus lacinnis 3, raro 4, staminibusque aequo numero superpositis, filamento brevi antheraque 2-loculari rimis longitudinalibus dehiscente. Flos femineus tubo ellipsoidei ovarium continente, laciniis 3, raro 4 vel 5, stigmateque coniformi.

To the characters of the generative parts the following peculiarities of the vegetative parts may be added:

The long stems keep their herbaceous appearance, and at length they become woody, without losing their green color, and without forming cork and lenticels; they are slender and strongly dichotomous, here and there tri- or tetrachotomous, as in the axils of the pair of leaves preceding a terminal inflorescence there are usually formed 2, more rarely 3 or 4, lateral branches. The leaves are opposite, the successive pairs of normal leaves often alternating with pairs of strongly reduced scalelike leaves, seemingly forming indistinct rings around the internodes, and making the normal leaves superposed.

The genus *Ginalloa* is spread in Burma, Siam, Indo-China, Ceylon, the Andaman Islands, the Philippines, and the western and central parts of the Malay Archipelago. In the Philippines it is found from northern Luzon to southern Mindanao. I have united the species described for the Philippines as one species, elevated one variety to the rank of species, and named one new species.

*Key to the Philippine species of Ginalloa.*

1. Leaves linear-lanceolate, not more than 7 mm, usually 2 to 3 mm, broad. 2. *G. angustifolia.*
   Leaves broader ........................................ 2.
2. Leaves ovate, obtuse-acuminate to narrowly lanceolate, obtuse; rudimentary leaves usually present, placed 5 to 60 mm above the normal ones, the internode below the rudimentary leaves not thickened and never having the appearance of a sheath.................... 1. *G. Arnottiana.*
   Leaves ovate, obtuse or rotundate at the apex; rudimentary leaves always present, 2 to 3 mm above the normal ones, the internode below them thickened, having the appearance of a sheath around the base of the normal internode.................... 3. *G. ovata.*

**1. GINALLOA ARNOTTIANA Korthals.**

*Ginalloa Arnottiana* KORTH., Verh. Bat. Genootsch. 17 (1839) 260; WALP., Repert. 2 (1843) 439; MIQ., Fl. Ind. Bat. 1 1 (1856) 807; OLIV., Journ. Linn. Soc. Bot. 7 (1864) 103; BENTH. and HOOK. F., Gen. Pl. 3 (1880) 215; VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 646; 43 (1896) 162; ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 139; BOERL., Handl. Fl. Ned. Ind. 3 1 (1900) 167, 171; MERR., Journ. Str. Br. Roy. As. Soc. Special No. 1921 (1921) 240; DANS., Bull. Jard. Bot. Buitenzorg III 11 (1931) 449.

*Viscum spicatum* KORTH., Verh. Batav. Genootsch. 17 (1839) 231–235.

*Viscum Cumingianum* PRESL, Epim. Bot. (1851) 255; WALP., Annal. 2 (1852) 729; BENTH. and HOOK. F., Gen. Pl. 3 (1880) 215.

*Ginalloa Cumingiana* FER.-VILL., Nov. App. (1880) 185; VIDAL, Pl. Cuming. Philip. (1885) 77, 141; Rev. Pl. Vasc. Filip. (1886) 232; ENGL., in Engl. and Pr., Nat. Pfl. fam. 3 1 (1889) 192; VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 646; 43 (1896) 162; MERR., Philip. Journ. Sci. § C 4 (1909) 153 excl. var. *angustifolia;* MERR. and MERRITT, Philip. Journ. Sci. § C 5 (1910) 345; MERR., Enum. Philip. Fl. Pl. 2 (1923) 112 excl. var. *angustifolia.*

*Ginalloa Zollingeri* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 647; 43 (1896) 162; ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 139; BOERL., Handl. Fl. Ned. Ind. 3 1 (1900) 167, 171; KOORD., Exkursionsfl. Java 2 (1912) 166.

*Ginalloa Beccariana* VAN TIEGH., Bull. Soc. Bot. Fr. 42 (1895) 647; 43 (1896) 162; ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 139; BOERL., Handl. Fl. Ned. Ind. 3 1 (1900) 167, 171; MERR., Journ. Str. Br. Roy. As. Soc. Special No. 1921 (1921) 240.

*Ginalloa lanceolata* C. B. ROB., Philip. Journ. Sci. § C 6 (1911) 200; MERR., Enum. Philip. Fl. Pl. 2 (1923) 112.

*Ginalloa platyphylla* MERR., Philip. Journ. Sci. 29 (1926) 477.

Omnis glabra. Internodia teretia, postea nodis folia evoluta ferentibus magis incrassatis; caulis partes inter foliorum paria evoluta 2 ad 10 cm longa, 0.75 ad 2.5 mm crassa; internodia sub foliis rudimentariis ("vaginae") 0.5 ad 6 cm longa. Folia normalia plerumque cum rudimentariis alternantia, plerumque lanceolata vel anguste lanceolata, rarius ovato-lanceolata vel ovata, sessilia basi valde angustata vel petiolo ad 5 mm longo, 5 ad 12 cm longa, 0.7 ad 5 cm lata, apicem obtusum versus magis vel minus (saepe valde) acuminata vel etiam in acumen longum protracta, crassiuscula subcoriacea, faciebus vix diversis, opacis subcurvinervia, costa fere usque ad apicem visibili, nervis lateralibus 2 curvatis vix brevioribus et in foliis latis 2 alteris brevioribus et tenuioribus, venisque conectivis facie inferiore paulo distinctioribus quam facie superiore. Inflorescentiae ad 10 cm

longae, basi internodiis ad 10 mm longis, c. 0.3 mm crassis apice paulum applanatis, versus spicae apicem gradatim brevioribus; paria bractearum connatarum 1.5 ad 2 mm diametro, juventute distincte angustiora, postea aequilata, triadibus florum decussatis vel superpositis, bracteis rudimentariis rarissime visibilibus. Flos masculus statu alabastri globosus c. 0.5 mm longus, postea paulum apertus, mox deciduus; flos femineus c. 1 ad 1.5 mm longus, tubo ellipsoide tres quartas longitudinis occupante laciniisque rotundato-triangulis. Fructus ellipsoides, levis, ad 10 mm longus, perigonii laciniis coronatus.

The above description has been made after Philippine material only, which cannot be separated from *G. Arnottiana*, widely spread in the central part of the Malay Archipelago and of which *G. Cumingiana* is a narrow-leaved type and *G. platyphylla* a broad-leaved type. Of *G. lanceolata* I have seen neither the type (*Bur. Sci. 10429 McGregor*), from Polillo, nor the second specimen cited by Merrill in his Enumeration (*Elmer 15690*). I have seen *Elmer 15696*, from Bulusan Volcano, Sorsogon, Luzon, strikingly agreeing with the original description, but neither this specimen, nor the other specimens named *G. lanceolata* by Merrill, nor the description, allow me to keep *G. lanceolata* separate from the polymorphic *G. Arnottiana*. Merrill's variety *angustifolia*, however, is different and can be taken as a separate species.

Perhaps the name *Viscum spicatum* has not only page priority over *Ginalloa Arnottiana*, but so long as I do not know with certainty that it was published earlier than *G. Arnottiana*, I prefer to use the latter name.

On the herbarium labels the fruit is indicated as red.

Philippines, without exact locality, *Cuming 1968* (L, Br), probably type number of *Ginalloa Cumingiana* Presl. LUZON, Cagayan Province, Maunan, *Bur. Sci. 7829 Ramos* (M); Mount Bawa, 360 m altitude, *Bur. Sci. 78451 Edaño* (M): Isabela Province, Santiago, *Clemens 18028* (M, UC, NY); San Mariano, 300 m altitude, *Bur. Sci. 46923 Ramos and Edaño* (UC, NY): Apayao Subprovince, Kabugao, *Bur. Sci. 28258 Fénix* (M, NY, B, L): Nueva Vizcaya Province, Dupax, *Bur. Sci. 11329 McGregor* (M, S): Rizal Province, Mount Susung-Dalaga, 100 m altitude, *Bur. Sci. 29376 Ramos and Edaño* (M, B, L): Tayabas Province, Mount Binuang, 34 m altitude, *Bur. Sci. s. n. Ramos and Edaño* (M): Sorsogon Province, Mount Bulusan, Irosin, *Elmer 15696* (M). CATANDUANES, Masanganbahi stream, 150 m altitude, *Bur. Sci. 75644 Ramos and Edaño* (M, NY, S, U). BOHOL, Bilar, 600 m altitude, *Bur. Sci. 43226 Ramos* (UC), type of *Ginalloa platyphylla* Merr.; Sevilla, 300 m altitude, *Bur. Sci. 43332 Ramos* (M, UC, B). DINAGAT, iron deposit, low altitude, *Bur. Sci. 83807 Ramos and Convocar* (M). MINDANAO, Surigao Province, Placer, 150 m altitude, *Wenzel 3038* (M, UC, B): Agusan Province, Mount Urdaneta, Cabadbaran, *Elmer 14179* (M, NY, B, L).

Further distribution: Borneo, Celebes, Salajar, Soelabesi, and Lombok.

**2. GINALLOA ANGUSTIFOLIA (Merrill) Danser.** Plate 2, fig. 1.

*Ginalloa cumingiana* var. *angustifolia* MERR., Philip. Journ. Sci. § C 4 (1909) 153; Enum. Philip. Fl. Pl. 2 (1923) 112.

Omnis glabra. Ramuli gracillimi et tenuissimi, teretes, statu adulto nodis folia normalia ferentibus leviter applanatis, folia adulta ferentes 0.3 ad 1.25 mm crassi, partes inter paria foliorum normalium 1.5 ad 5 cm longae, internodia sub foliis rudimentariis ("vaginae") 1 ad 30 mm longa. Folia opposita, decussata; normalia saepe cum paribus rudimentariis alternantia, superposita, lineari-lanceolata, sessilia vel subpetiolata, 3 ad 7 cm longa, plerumque 2 ad 3, rarius 1 ad 5, rarissime ad 7 mm lata, basin versus sensim attenuata, apicem obtusum vel rotundatum versus minus attenuata, crasse vel tenuiter coriacea, faciebus similibus, opacis, costa nervisque lateralibus 2 usque ad apicem fere parallelis, raro nervis 2 alteris brevioribus tenuioribusque, venis connectivis plerumque invisibilibus. Inflorescentiae plerumque 1 ad 5 cm longae, internodiis c. 2 ad 4 mm longis, apicem versus paulum applanatis et dilatatis, paribus bractearum connatarum 1 ad 1.5 mm diametro, juventute angustioribus, postea aequilatis. Flos masculus globosus, vix 0.5 mm longus, flos femineus ad 1 mm longus, tubo ellipsoide duas tertias longitudinis occupante, laciniis conniventibus. Fructus ellipsoides, peringonii lacinis coronatus, ad 6 mm longus, 3 mm crassus.

The differences between *G. Arnottiana* and *G. angustifolia* are not large, but they are as large as those between several other *Ginalloa* species, and intermediate forms are wanting among the rather abundant herbarium specimens.

*Ginalloa angustifolia* is spread in northern and central Luzon and in Negros, and has been collected from 35 to 1,300 m altitude. The fruit is indicated as red on the herbarium labels.

LUZON, Ilocos Norte Province, Burgos, 35 m altitude, *Bur. Sci. 27264 Ramos* (M): Isabela Province, Mount Moises, *Clemens 16708* (M, UC, NY): Benguet Subprovince, Baguio, *Elmer 8941* (NY, B, L); Mount Pulog, *F. B. 16242 Curran, Merritt, and Zschokke* (NY), first number cited for *G. cumingiana* var. *angustifolia:* Nueva Vizcaya Province, Dupax, *Bur. Sci. 11342 McGregor* (M, G, Br): Rizal Province, Montalban, *Loher 13268* (M, UC): Laguna Province, Dahican, *Ramos 1150* (M, U, Br); Pabontoc River, Paete, 310 m altitude, *F. B. 26780 Mabesa* (M). NEGROS, *F. B. 20680 Tamesis* (M); Canlaon Volcano, *Bur. Sci. 1139 Banks* (M), second number cited for *G. cumingiana* var. *angustifolia,* type of *Ginalloa angustifolia;* Mount Marapara, 1,200 to 1,300 m altitude, *F. B. 13627 Curran and Foxworthy* (M); Gantanan, 300 m altitude, *F. B. 20886 Hinoban* (M).

### 3. GINALLOA OVATA Danser sp. nov. Plate 1, fig. 8.

Omnis glabra. Ramuli ramosissimi, teretes, ad nodos folia normalia ferentes incrassatis, folia adulta ferentes 1 ad 2 mm crassi, partes interparia foliorum normalium 2 ad 7 cm longae, internodia sub foliis rudimentariis ("vaginae") 2 ad 3 mm longis, paulo crassiora quam internodia supra folia rudimentaria. Folia opposita, decussata, normalia semper cum rudimentariis alternantia, superposita, sessilia vel subpetiolata, ovata, saepe paulum obliqua, 4 ad 6 cm longa, 1.5 ad 3.5 cm lata, sub basi rotundata contracta, apice obtusa vel rotundata, crassa, faciebus similibus, opacissimis, curvinervibus, costa usque fere ad apicem visibili, nervis lateralibus curvatis 4, quorum interiores usque fere ad apicem, exteriores ad dimidiam folii longitudinem percurrentes, venis ceteris invisibilibus. Inflorescentiae plerumque 2 ad 4 cm longae, basi internodiis 2 ad 3 mm longis, apicem versus brevioribus; bractearum paria connata 1.5 ad 2 mm diametro. Flos masculus subglobosus, c. 0.5 mm longus. Flos femineus 1 ad 1.5 mm longus, tubo duas tertias longitudinis occupante, laciniis conniventibus. Fructus ignotus.

*Ginalloa ovata* shows no large differences from *G. Arnottiana,* but the differences are as distinct as those between many other species, and the materials from the two localities are strikingly similar.

LUZON, Tayabas Province, Tanatakutan, 400 m altitude, *F. B. 30844 Oro* (M, type, NY, S, cotypes): Sorsogon Province, Mount Bulusan, Irosin, *Elmer 161139* (B).

### XV. Genus KORTHALSELLA Van Tieghem

*Korthalsella* VAN TIEGH., Bull. Soc. Bot. Fr. 43 (1896) 86, 163; ENGL., in Engl. and Pr., Nat. Pfl. Fam. Nachtr. (1) zu 2–4 (1897) 138; BOERL., Handl. Fl. Ned. Ind. 3 1 (1900) 171; GAMBLE, Journ. As. Soc. Beng. 75 2 (1914) 384; MERR., Bot. Mag. Tokyo 30 (1916) 68; HAYATA, Bot. Mag. Tokyo 30 (1916) 69; LECOMTE, Bull. Mus. Hist. Nat. Paris 22 (1916) 263; RIDL., Fl. Mal. Pen. 3 (1924) 163; GAMBLE, Fl. Madras 7 (1925) 1256; BLAKELEY, Proc. Linn. Soc. N. S. Wales 53 (1928) 31; DANS., Bull. Jard. Bot. Buitenzorg III 11 (1931) 452.

*Bifaria* VAN TIEGH., Bull. Soc. Bot. Fr. 43 (1896) 163, 164; MERR., Enum. Philip. Fl. Pl. 2 (1923) 113.

*Heterixia* VAN TIEGH., Bull. Soc. Bot. Fr. 43 (1896) 163, 177.

*Pseudixus* HAYATA, Ic. Pl. Formos. 5 (1915) 187; Bot. Mag. Tokyo 29 (1915) 31; 30 (1916) 69.

Suffrutices, foliis valde reductis. Flores principio singuli in axillis, postea floribus adventivis collateralibus et serialibus acuti, bracteis destituti. Flos masculus laciniis 3, staminibus 3 antheris cohaerentibus bilocularibus, latere interiore rimis 2 dehiscentibus; flos femineus tubo ovarium continente, laciniis 3, stigmate brevi sessili.

The genus *Korthalsella* is spread in southeastern Asia from the Himalayas to Japan, the Philippines, the Malay Peninsula, and Java; also in Australia and the archipelagoes east of it, the islands in the Indian Ocean, Abyssinia, and South Africa. In the Philippines it is represented by one species only, which has been found as a parasite on trees on high mountain tops in Luzon and Negros, in the same way as in the Malay Peninsula and Java.

**1. KORTHALSELLA OPUNTIA (Thunberg) Merrill.**

*Viscum opuntia* THUNB., Fl. Jap. (1784) 64; MERR., Philip. Journ. Sci. § C 4 (1909) 152.

*Viscum japonicum* THUNB., Trans. Linn. Soc. Lond. 2 (1794) 329.

*Bifaria japonica* VAN TIEGH., Bull. Soc. Bot. Fr. 43 (1896) 173.

*Korthalsella japonica* ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 138.

*Pseudixus japonicus* HAYATA, Ic. Pl. Formos. 5 (1915) 188; Bot. Mag. Tokyo 29 (1915) 31; 30 (1916) 68.

*Korthalsella opuntia* MERR., Bot. Mag. Tokyo 30 (1916) 68; DANS., Bull. Jard. Bot. Buitenzorg III 11 (1931) 453, ic. 25*b;* VAN STEENIS, Trop. Nat. 22 (1933) 112 cum ic.

*Korthalsella moniliformis* LEC., Bull. Mus. Hist. Nat. Paris 22 (1916) 265.

*Bifaria opuntia* MERR., Enum. Philip. Fl. Pl. 2 (1923) 113; GROFF and DING, Lingn. Agr. Rev. 1 (1923) 76.

For a more extensive list of literature cfr. Bull. Jard. Bot. Buitenzorg III 11: 453.

Erecta, ramosissima, ad 12 cm alta, glabra, pilis inter flores positis exceptis. Internodia valde applanata, applanatione non alternantia, utraque facie nervis prominentibus plerumque 1 vel 3, rarius 0 vel 5, circuitu obovata ad lanceolato-obovata, apice limbo brevi, supra latera plana lobum brevem latumque obtusum, sub axillis dentem brevem erectum formante, inferiora angusta, deinde majora et latiora, apices ramulorum versus minora et pro longitudine latiora, maxima ad 25 mm longa 10 mm lata. Flores numerosi, in axillis positi, vix 0.5 mm longi. Fructus piriformis, ad 1.5 mm longus.

LUZON, Benguet Subprovince, *Loher 4475* (M) ; Pauai, 2,100 m altitude, *Bur. Sci. 8403 McGregor* (M) ; Mount Pulog, 2,460 m altitude, *F. B. 16074 Curran, Merritt, and Zschokke* (M, Be) ; 2,400 m altitude, on *Amyema verticillata, Bur. Sci. 44934 Ramos and Edaño* (UC) : Zambales Province, Mount Tapulao, exposed mountain top over 2,000 m altitude, *F. B. 8080 Curran and Merritt* (M). NEGROS, Canlaon Volcano, *Merrill 7030* (M, B, L, Be).

### XVI. Genus NOTOTHIXOS Oliver

*Notothixos* OLIVER, Journ. Linn. Soc. Bot. 7 (1864) 92, 103; BENTH., Fl. Austr. 3 (1866) 396; BENTH. and HOOK. F., Gen. Pl. 3 (1880) 214; BAILEY, Syn. Queensl. Fl. (1883) 452; HOOK. F., Fl. Br. Ind. 5 (1886) 227; ENGL., in Engl. and Pr., Nat. Pfl. fam. 3 1 (1889) 192; TRIMEN, Handl. Fl. Ceyl. 3 (1895) 473; VAN TIEGH., Bull. Soc. Bot. Fr. 43 (1896) 186; ENGL., in Engl. and Pr., Nat. Pfl. fam. Nachtr. (1) zu 2–4 (1897) 139; BOERL., Fl. Ned. Ind. 3 1 (1900) 156, 161, 167, 171; MERR., Philip. Journ. Sci. § C 4 (1909) 130, 152; GAMBLE, Journ. As. Soc. Beng. 75 2 (1914) 390; KRAUSE, in Engl., Jahrb. 57 (1922) 492; MERR., Enum. Philip. Fl. Pl. 2 (1923) 112; RIDL., Fl. Mal. Pen. 3 (1924) 165; BLAKELEY, Proc. Linn. Soc. N. S. Wales 53 (1928) 38; DANS., Bull. Jard. Bot. Buitenzorg III 11 (1931) 456.

Inflorescentia spicata vel racemosa vel paniculata, composita e cymis 3-floris vel floribus collateralibus auctis (floribus ad 9), vel cymae singulae axillares. Flos masculus laciniis 4, staminibus aequo numero superpositis, filamento brevi antheraque horizontaliter locellata, singulis locis singulis poriis dehiscentibus. Flos femineus tubo ellipsoide, laciniis 4 erectis breve triangularibus, stylo papilli vel coniformi.

To the characters enumerated above, the following taken from the vegetative parts may be added: The species of this genus are small, strongly branched shrubs; all young parts are covered with a dense tomentum of stellate hairs. Normal leaves are always present and opposite, but are often alternating with one

more pair of scalelike leaves, and in that case they seem often to be superposed.

The genus *Notothixos* is spread in the eastern part of the Old World Tropics, from Ceylon to the Philippines and to Australia. In the Philippines it is found from central Luzon to Mindanao.

*Key to the Philippine species of Notothixos.*

1. Cymes 5- to 9-flowered, peduncled, united to a paniculate raceme. 3. *N. leiophyllus.*
   Cymes usually 3-flowered, rarely 5-flowered, decussately arranged in spikes ........ 2.
2. Leaves usually elliptic-oblong; spikes up to 1 cm long.... 1. *N. Curranii.*
   Leaves roundish-ovate; spikes 2 to 4 cm long........ 2. *N. sulfureus.*

### 1. NOTOTHIXOS CURRANII Merrill.

*Notothixos curranii* MERR., Philip. Journ. Sci. § C 4 (1909) 152; Enum. Philip. Fl. Pl. 2 (1923) 113.

Omnes partes juveniles tomento denso primum sulfureo postea dilute ochraceo vestitae; caules glabrescentes; folia facie superiore mox glabrescentia, inferiore tomento tenuescente canescente. Caules graciles, ramosissimi, di- vel trichotomi, internodiis teretibus nodis paulum applanatis et dilatatis, folia adulta ferentibus plerumque 1 ad 3.5 cm longis, 0.75 ad 1 mm crassis. Folia opposita; petiolus ad 5 mm longus 0.5 mm crassus, subtus rotundatus supra canaliculatus, difficile a lamina distinguendus; lamina elliptico-oblonga vel ovato-oblonga, plerumque 1.5 ad 4 cm longa, 0.6 ad 2 cm lata, sub basi cuneata in petiolum contracta, apicem obtusum versus cuneata, tenuiter coriacea, supra sublucida, curvinervis, costa nervisque lateralibus 2 usque fere ad apicem percurrentibus, nonnunquam etiam nervis lateralibus 2 brevioribus tenuioribus, venis connectivis partim visibilibus. Inflorescentiae spicae terminales triadum decussatarum, ad 1 cm longae, internodiis 2 ad 3 mm longis c. 0.75 mm crassis, bracteis acute semi-infundibuliformibus, c. 0.75 mm longis. Flores feminei c. 1.5 mm longi, tubo breve ellipsoide c. 1 mm longo, laciniis 4 triangularibus obtusis vix 0.5 mm longis. Fructus ellipsoides, apice basique nonnihil attenuatus, perigonii laciniis permanentibus paulum auctis coronatus, maxime 4 mm longus 3 mm crassus; semen ovale, complanatum, c. 4 mm longum, 3 mm latum, 1 mm crassum.

*Notothixos Curranii* is closely allied to *N. spicatus* from New Guinea and Java, but has not the golden-yellow indumentum of that species and shows several other small differences.

LUZON, Bataan Province, Mount Limay, *F. B. 12402 Merritt and Curran* (M, type Ny, Be, cotypes of *Notothixos Curranii* Merr.) : Rizal Province, Montalban, *Loher 6735* (M, Be) ; Mount Lumutan, *Bur. Sci. 29662 Ramos and Edaño* (B). SIBUYAN, Capiz Province, Mount Giting-giting, Magallanes, *Elmer 12467* (M, NY, B, L, U). MINDANAO, Agusan Province, Mount Urdaneta, Cabadbaran, *Elmer 14071* (M, UC, NY, L, U, Be).

**2. NOTOTHIXOS SULFUREUS Merrill.**

*Notothixos sulphureus* MERR., Philip. Journ. Sci. § C 4 (1909) 152; Enum. Philip. Fl. Pl. 2 (1923) 113.

Omnes partes juveniles tomento denso sulfureo vestitae; caules mox glabri, folia facie superiore mox glabrescente inferiore tomento tenuescente paulum canescente. Caules graciles, ramosissimi, di- vel trichotomi, internodiis teretibus nodis paulum dilatatis et applanatis, folia adulta ferentibus plerumque 2.5 ad 5 cm longis 1 ad 1.5 mm crassis. Folia opposita; petiolus 3 ad 6 mm longus, c. 0.75 mm latus, subtus rotundatus supra canaliculatus; lamina ovata, sub basi rotundata abrupte in petiolum contracta, apice rotundata, plerumque 2.5 ad 5 cm longa, 2 ad 3.5 cm lata, tenuiter coriacea, supra opaca, curvinervis costa nervisque 2 lateralibus usque fere ad apicem percurrentibus, nervis 2 exterioribus dimidiam folii longitudinem attingentibus, venis connectivis partim vissibilibus. Inflorescentiae spicae terminales triadum decussatarum, 2 ad 4 cm longae, internodiis 2 ad 4 mm longis 0.3 ad 0.5 mm crassis, bracteis semi-infundibuliformibus, acutis, c. 1 mm longis. Flos masculus globosus, bene 0.5 mm longus; flos femineus c. 1.5 mm longus, tubo breve ellipsoide c. 1 mm longo, laciniisque 4 erectis triangulis vix 0.5 longis. Fructus juvenilis anguste ellipsoides, apice basique acutus, perigonii laciniis permanentibus paulum acutis coronatus, maturus ignotus.

*Notothixos sulfureus* is closely allied to *N. Curranii,* and further material is needed to determine whether or not these two are separate species. *Notothixos sulfureus* is the larger and more robust in all parts, and its longer spikes are especially notable.

MINDANAO, Zamboanga Province, *F. B. 13773 Foxworthy, Demesa, and Villamil* (L, Be) ; Banga, *F. B. 9132 Whitford* (M, type of *Notothixos sulphureus* Merr.).

Further distribution: Borneo.

**3. NOTOTHIXOS LEIOPHYLLUS Schumann.**

*Notothixos leiophyllus* SCHUM., in Schum. and Lauterb., Nachtr. (1905) 260; KRAUSE, in Engl., Jahrb. 57 (1922) 494; BLAKELY, Proc. Roy. Soc. Queensl. 34 (1922) 63; MOORE, Journ. Bot. 61 (1923) 44; BLAKELY, Proc. Linn. Soc. N. S. Wales 53 (1928) 41; WHITE, Journ. Arnold Arbor. 10 (1929) 210; (*lioph.*) DANS., Bull. Jard. Bot. Buitenzorg III 11 (1931); WHITE, Contr. Arn. Arb. 4 (1933) 25.

*Notothixos philippinense* ELMER, Leafl. Philip. Bot. 2 (1908) 471; (*-sis*) MERR., Philip. Journ. Sci. § C 4 (1909) 153; Enum. Philip. Fl. Pl. 2 (1923) 112.

Omnes partes juveniles tomento denso aureo vestitae, caules mox glabri, folia facie superiore mox glabrescentia, facie inferiore tomento diu permanente, inflorescentiis tomento floccoso permanente. Caules graciles tenuesque, ramosissimi plerumque dichotomi; internodiis teretibus, folia adulta ferentibus plerumque 1.5 ad 10 cm longis, 1 ad 2.5 mm crassis, nodis incrassatis paulum dilatatis. Folia opposita, petiolus vix a lamina distinguendus, subtus rotundatus, supra leviter canaliculatus; lamina ovata, plerumque 4 ad 9 cm longa, 1.8 ad 5 cm lata, sub basi cuneata vel late rotundata in partem petioliformen abrupte contracta, apicem obtusum versus magis minusve acuminata, tenuiter coriacea, supra opaca vel sublucida, curvinervis costa nervisque lateralibus 2 ad 4, quorum interiores usque fere ad apicem, exteriores ad dimidiam folii longitudinem percurrentes. Inflorescentiae paniculatae, plerumque 1 ad 7 cm longae, axi 0.5 ad 0.75 mm crasso, ex internodiis 1 ad 12 composito; cymis pedicellatis decussatis vel in nodis inferioribus compluribus seriatim dispositis, pedicellis inferioribus ad 4 mm longis 0.5 mm crassis, magis apicem versus et in inflorescentiis minoribus brevioribus, apice semiorbiculariter dilatatis, bracteis lateralibus acutis ad 0.5 mm longis, ad 9-floris. Flos femineus oblongo-ellipsoides, tubo tres quartas longitudinis occupante, laciniisque 4 breve triangulis erectis. Flos masculus globosus vel obovatus, c. 0.75 mm longus. Fructus ellipsoides, maximus ad 5 mm longus 3 mm crassus, laciniis perigonii paulum auctis coronatus.

This description is after the Philippine specimens only.

NEGROS, Oriental Negros Province, Cuernos Mountains, Dumaguete, 300 m altitude, *Elmer 10114* (M, NY, B, L, Be, cotypes of *Notothixos philippinense* Elm.). MINDANAO, Bukidnon Province, Balambangan, Malaybalay, 766 m altitude, *F. B. 26541 Rola* (M).

Further distribution: Amboyna, New Guinea, New Pommern, and Queensland.

### XVII. Genus VISCUM Linnæus

*Viscum* Linn., Sp. Pl. ed. 1 2 (1753) 1023; Merr., Philip. Journ. Sci. § C 4 (1909) 130, 151; Enum. Philip. Fl. Pl. 2 (1923) 113; Dans., Bull. Jard. Bot. Buitenzorg III **11** (1931) 459.

*Aspidixia* Van Tiegh., Bull. Soc. Bot. Fr. **43** (1896) 191.

For a more extensive list of literature cfr. Bull. Jard. Bot. Buitenzorg III **11**: 459.

Inflorescentiae cymae simplices 3-florae, bracteolis 2, saepe ad florem medium reductae, nonnunquam floribus collateralibus auctae, sessiles vel pedunculatae, raro in inflorescentias majores compositae. Flos masculus tepalis 4 liberis, staminibusque aequo numero, antheris sessilibus dorso cum tepalis connatis, irregulariter multilocellatis, singulis locellis singulis poris dehiscentibus. Flos femineus tubo brevi ovarium continente, laciniis 4, stigmate sessile brevi.

The genus *Viscum* is widely spread in the Old World; most species are African, and their number decreases toward the East. In Australia only few species occur. The pretended occurrence of *Viscum articulatum* east of Australia is based upon confusion with *Korthalsella* species. In the Philippines three species are found, none of which is endemic.

*Key to the Philippine species of Viscum.*

1. Leafy .................................................. 1. *V. orientale.*
   Leafless .................................................. 2.
2. Internodes not or hardly flattened, not slender; fruit warty, crowned by the permanent perigone lobes .................................................. 3. *V. Loranthi.*
   Internodes slender, usually flattened; fruit always smooth; perigone lobes deciduous .................................................. 2. *V. articulatum.*

#### 1. VISCUM ORIENTALE Willdenow.

*Viscum orientale* Willd., Sp. Pl. ed. 4 2 (1805) 737; Fer.-Vill., Nov. App. (1880) 184; Vidal, Pl. Cuming. Philip. (1885) 76, 77, 141; Rev. Pl. Vasc. Filip. (1886) 232; Merr., Philip. Journ. Sci. § C 4 (1909) 151; Species Blanco. (1918) 132; Enum. Philip. Fl. Pl. 2 (1923) 114; Dans., Bull. Jard. Bot. Buitenzorg III **11** (1931) 466.

*Viscum Heyneanum, ovalifolium, obtusatum* DC., Prodr. 4 (1830) 278, 279.

*Viscum verticillatum* Roxb., Fl. Ind. ed. 2 3 (1832) 764.

*Viscum pamattonis, navicellatum, Roxburghianum* Korth., Verh. Bat. Genootsch. **17** (1879) 255–257.

*Viscum monoicum* Presl., Epim. Bot. (1849) 251 ? non DC.

For a more extensive list of literature cfr. Bull. Jard. Bot. Buitenzorg III **11**: 466.

Omnis glabra. Caules graciles, ramosissimi, internodiis teretibus, saepe apice paulum applanatis, nodis semper incrassatis, folia adulta ferentibus 1 ad 5 cm longis, 0.75 ad 2.5 mm crassis. Folia opposita, sessilia vel breve petiolata; petiolus difficile a lamina distinguendus, pauca 1 mm longus; lamina lanceolata ad elliptica vel magis minusve obovata, plerumque 4 ad 10 cm longa, 1.5 ad 3.5 cm lata, basi sensim attenuata, apice obtusa vel rotundata, rarius acutiuscula, coriacea, utrinque opaca, flabellinervis, nervis longitudinalibus plerumque 3 vel 5 distinctis, venis tenuioribus convexis. Cymae singulae in foliorum axillis primum 3-florae flore medio femineo lateralibus masculis, rarius ad florem medium reductae, postea saepe floribus adventivis auctae denique multiflorae, bracteolis 2 oppositis breve triangulis in unum naviculiforme c. 1.5 mm longum connatis. Flos masculus 0.75 ad 1 mm longus, globosus vel lateraliter compressus, tepalis 4 crassiusculis breve triangulis, antheris sessilibus dorso adnatis suborbicularibus valde applanatis; flos femineus 1.5 ad 2 mm longus, tubo cylindrico duas tertias longitudinis occupante, laciniis 4 breve 3-angulis, post deciduis. Fructus rotundato-ellipsoides, ad 5 mm longus 4 mm crassus, diu verriculosus tota maturitate levis, ochraceo vel fusco viridis, stylo permanente paulum aucto coronatus.

Philippines, without exact locality, *Cuming 1954* (M), *1948, 1950, 1961* (M, L), *2341* (L), *Loher 6734* (M). LUZON, Benguet, Subprovince, *Loher 4468* (M): Pangasinan Province, Sibtong, Villasis, *Alberto 2* (M); Mount San Isidro, 200 m altitude, *Bur. Sci. 29909 Fénix* (M, B): Nueva Vizcaya Province, Bongabon, *F. B. 8454 Curran* (M, NY, S, Be): Bataan Province, Lamao River, Mount Mariveles, 450 m altitude, *Williams 474* (NY); Lamao Forest Reserve, *F. B. 7230 Curran* (M): Rizal Province, Antipolo, *Merrill Sp. Blanco. 883* (M, NY, B, L, Be); *Bur. Sci. 10909 Ramos* (M, S): Laguna Province, Forestry Plantation, 100 m altitude, *F. B. 24906 Mabesa* (M); Mount Maquiling, Los Baños, *Elmer 17798* (M, UC, B, L, U) and *17916* (M, B, L, U): Tayabas Province, Malicbuy, *Bur. Sci. 26898 Edaño* (M); 60 m altitude, *Bur. Sci. 26919 Edaño* (M, UC, B). LUBANG, sea level, *Merrill 961* (M, NY). PALAWAN, *F. B. 3814 Curran* (M, B); Alfonso XIII, *Bur. Sci. 15529 Fénix* (M, S, Be); Addison Peak, Brooks Point, *Elmer 12700* (NY, B, L). MINDANAO, Davao Province, Mati, Bitanagan River, 150 m altitude, *Bur. Sci. 49005 Ramos and Edaño* (UC).

Further distribution: Tropical southeastern Asia, Malay Archipelago, North Australia.

**2. VISCUM ARTICULATUM Burman.**

*Viscum articulatum* BURM., Fl. Ind. (1768) 211; FER.-VILL., Nov. App. (1880) 185; MERR., Philip. Journ. Sci. § C 4 (1909) 151; Sp. Blanco. (1918) 133; Philip. Journ. Sci. 19 (1921) 348; Enum. Philip. Fl. Pl. 2 (1923) 113; DANS., Bull. Jard. Bot. Buitenzorg III 11 (1931) 460.

*Viscum compressum* POIR., in Lam., Encycl. Méth. Suppl. 2 (1811) 861.

*Viscum opuntioides* BL., Catal. (1823) 112 nomen; ROXB., Fl. In. ed. 2 3 (1832) 764 non Linn.

*Viscum monilliforme* BL., Bijdr. 13 (1825) 667.

*Viscum dichotonum* D. DON, Prodr. Fl. Nep. (1825) 142.

*Viscum angulatum?* DC., Prodr. 4 (1830) 283; FER.-VILL., Nov. App. (1890) 184; MERR., Philip. Journ. Sci. § C 4 (1909) 151; Sp. Blanco. (1918) 133; Philip. Journ. Sci. 15 (1919) 234; Enum. Philip. Fl. Pl. 2 (1923) 113.

*Aspidixia articulata, dichototoma ? angulata* VAN TIEGH., Bull. Soc. Bot. Fr. 43 (1896) 193.

*Viscum flexuosum* GAMBLE, Kew Bull. 1913 (1913) 47.

For a more extensive list of literature cfr. Bull. Jard. Bot. Buitenzorg III 11: 460.

Omnis glabra. Caules graciles, ramosissimi, plerumque penduli, internodiis e basi tereti vel quadriangula magus minusve applanatis, raro omnino 4-angulis vel teretibus, 1 ad 5 cm longis, 0.5 ad 3 mm crassis, 1 ad 5 mm latis, applanationibus semper alternantibus, circuito linearibus ad lineari-obovatis, utrinque nervis nonnullis longitudinalibus. Folia ad squamas dentiformes reducta c. 0.5 mm longa. Cymae in axillis singulae, primum plerumque flore singulo femineo bracteolis 2 oppositis in cupulam vel naviculam connatis, sub quibus saepe bracteae decussatae diverso numero, ex axillis quarum postea saepe flores procrescunt bracteolis 2 connatis suffulti. Flos masculus primum globosus, postea paulum patens tepalis triangulis crassiusculis vix 0.25 mm longis, antheris suborbicularibus valde applanatis. Flos femineus breve ellipsoides, c. 0.5 mm longus, tubo cylindrico brevi duas tertias longitudinis occupante, laciniis perigonii breve triangulis, crassiusculis deciduis. Fructus globosus, levis, lucidus, maturitate semipellucidus, albidus, c. 3 mm diametro; semen lenticulare, marginibus obtusis, viride, embryis plerumque 1 raro 2 vel 3.

Though, in general, *Viscum articulatum* is indicated as growing on all kinds of trees, it seems to be overlooked that, as a rule, the real host is one of the coarse Loranthaceæ, such as *Dendrophthoe* or *Amyema.* Yet, now and then, *V. articulatum* grows directly on nonloranthaceous plants. Among the Phil-

ippine materials I found only *F. B. 6943* on *Casuarina,* from Baca, Zambales, Luzon, but this was such a finely branched form, that it might be a new species of *Viscum.* In the Netherlands Indies *Viscum articulatum,* besides the Loranthaceæ, is known with certainty only on *Evodia, Calotropis, Flueggea,* and *Henslowia.*

LUZON, Ilocos Norte Province, Bangui, *Bur. Sci. 7616 Ramos* (M); Burgos, *Bur. Sci. 27255 Ramos* (M); Piddig, *Bur. Sci. 43634 McGregor* (M, UC, B): Ilocos Sur Province, San Esteban, near Santa Maria, sea level, *Clemens 17854A* (UC); La Union Province, Bauang, sea level, *Elmer 5554* (M, NY, B, Be): Bontoc Subprovince, Mount Masapilid, 900 m altitude, *Bur. Sci. 37885 Ramos and Edaño* (M, Be); Lepanto Subprovince, Aluling, 1,000 m altitude, *Vanoverbergh 2194* (M); Benguet Subprovince, *F. B. 15894 Bacani* (M); Aduay, 900 m altitude, *F. B. 10923 Curran* (M, Be); Antamok, *Williams 1009* (M, NY); Mount Pulog, 1,250 m altitude, *F. B. 16243 Curran, Merritt, and Zschokke* (M, B); Baguio, *Elmer 8516* (M, NY, B, U): Cagayan Province, Malaguey, *Warburg 11706* (Be): Pangasinan Province, Alaminos, *F. B. 8347 Curran and Merritt* (M): Zambales Province, *F. B. 11051 Zschokke* (M, NY, B, Be); Bacao, *F. B. 6943 Curran* (M), directly on *Casuarina:* Bataan Province, Lamao Forest Reserve, *F. B. 7230 bis, Curran* (M): Bulacan Province, Calumpit, *Merrill, Sp. Blanco. 695* (M, NY, B, L): Rizal Province, Rio San Francisco del Monte, *Loher 4482* (M, NY, Be); *Merrill, Sp. Blanco. 792* (M, NY, B, L, Be): Laguna Province, Bay, 2.5 m altitude, *Holman 154* (M); Mount Maquiling, *Quisumbing s. n.* (UC): Tayabas Province, Umiray, *Bur. Sci. 29064 Ramos and Edaño* (M). MINDORO, Puerto Galera, 15 m altitude, *Bur. Sci. 15301 Kienholz* (NY); 10 m altitude, *Bur. Sci. 15222 Kienholz* (M, UC). LEYTE, Dagami, Panda, 60 m altitude, *Wenzel 275* (M). MINDANAO, Lanao Province, Lake Lanao, Camp Keithley, *Clemens 564* (M, Be): Davao Province, Mount Apo, Todaya, *Elmer 11963* (B, L, Be).

Further distribution: Southeastern tropical Asia, Malay Archipelago, and North Australia.

### 3. VISCUM LORANTHI Elmer.

*Viscum Loranthi* ELMER, Leafl. Philip. Bot. 8 (1919) 3089; MERR., Enum. Philip. Fl. Pl. 2 (1923) 113; DANS., Bull. Jard. Bot. Buitenzorg III 11 (1931) 464, ic. 27, *b, c.*

Caules rigidi, a basi ramosi, ad 10 cm longi, internodiis inferioribus ad 2 cm longis 4 mm crassis, teretibus, nodis incrassatis, superioribus gradatim brevioribus, leviter decussatim applanatis. Folia nulla. Cymae ad apices ramulorum decussatae, primum 3-florae flore medio femineo lateralibus masculis, postea floribus adventivis auctae, denique multiflorae. Flos masculus c. 0.75 mm longus, tepalis ovatis convexis acutis crassiusculis, antheris applanatis orbicularibus. Flos femineus c. 1 mm longus, tubo c. duas tertias longitudinis occupante, laciniis 4 ovato-triangulis crassiusculis, stylo brevi mammiformi. Fructus maturus ignotus, immaturus verruculosus, tepalis 4 permanentibus coronatus.

The description is from the Sumatran material of the Buitenzorg Herbarium, not from the ill-preserved specimens of the type number, which, however, appear to be entirely identical. The Luzon specimens appear to grow on *Taxillus estipitatus* (not on *Scurrula*), the Sumatra specimens on *Scurrula ferruginea.*

LUZON, Laguna Province, Mount Maquiling, Los Baños, *Elmer 17777* (M, UC, B, L, U, cotypes of *Viscum loranthi* Elm.), "on *Loranthus estipitatus*" according to Elmer, *Copeland 618117* (UC) "on *Loranthus:*" Rizal Province, Mount Kanumay, on *Taxillus estipitatus, Bur. Sci. Ramos 1020,* in Herb. Brit. Museum, London.

Further distribution: Central Sumatra.

## DOUBTFUL AND EXCLUDED SPECIES

Merrill[7] has listed doubtful and excluded specific names in this family; several of the names enumerated by him are only synonyms of species, in reality occurring in the Philippines, and are enumerated as such by me in the lists of synonyms. Species either doubtful or to be excluded are—

*Dendrophthoe incarnata* "Blume."
*Loranthus bicolor* Roxb.
*Loranthus Blancoanus* F.-Vill.
*Loranthus coccineus* Jack.
*Loranthus formosus* Blume.
*Loranthus Forsterianus* Schultz.
*Loranthus heteranthus* Wall.
*Loranthus pauciflorus* Blanco.
*Loranthus pulcher* DC.
*Loranthus retusus* Jack.
*Loranthus Wallichianus* Roxb.

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[7] Philip. Journ. Sci. § C 4 (1909) 148–149; Enum. Philip. Fl. Pl. 2 (1923) 111–112.

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# ILLUSTRATIONS

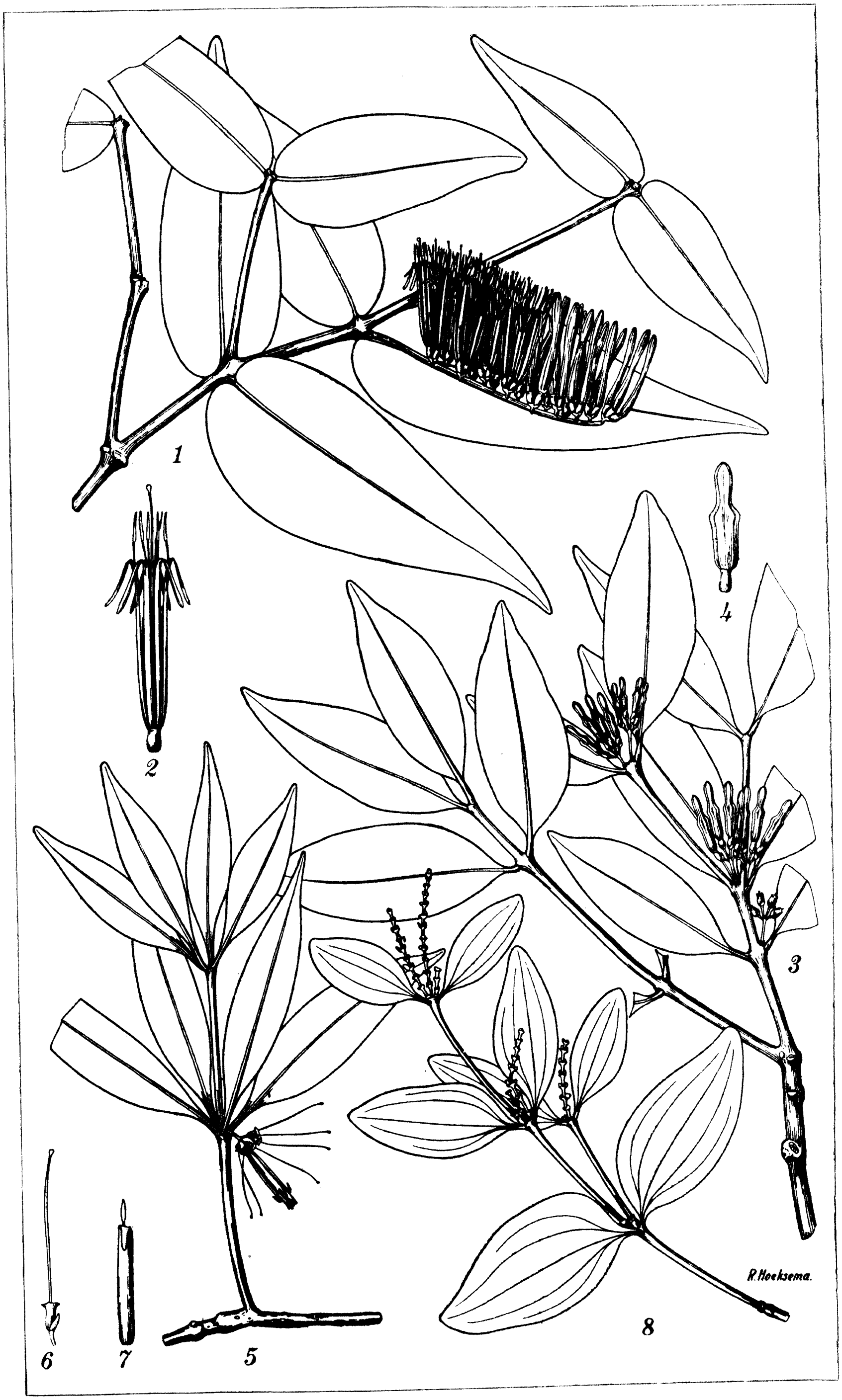
**[All branches with leaves and flowers are one-half natural size; other parts, natural size.]**

## PLATE 1

FIGS. 1 and 2. *Amylotheca amplexicaulis* Danser sp. nov.
3 and 4. *Macrosolen bellus* Danser sp. nov.
5 to 7. *Amyema mosea* Danser sp. nov.
FIG. 8. *Ginalloa ovata* Danser sp. nov.

## PLATE 2

FIG. 1. *Ginalloa angustifolia* (Merrill) Danser.
FIGS. 2 to 5. *Amyema aquilonia* Danser sp. nov.
6 to 10. *Dicymanthes suluana* Danser sp. nov.



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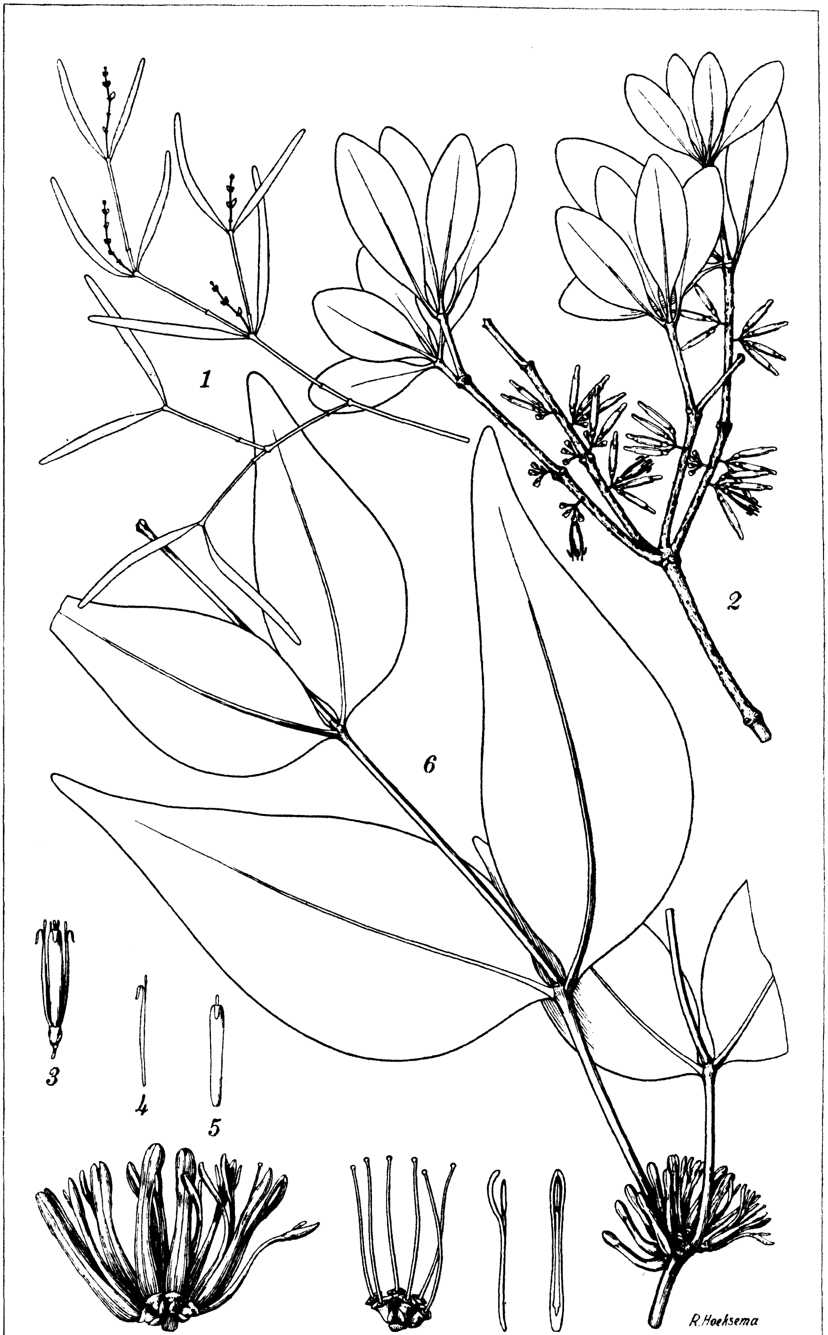

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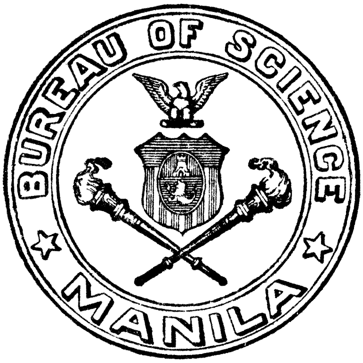

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# THE ANTIGENIC PROPERTIES OF THE CHOLERA VACCINE PREPARED BY THE PHILIPPINE BUREAU OF SCIENCE.

By KOUHEI SUGINO

*Of the Division of Biological Products, Bureau of Science, Manila*

During the last thirty or more years vaccination against cholera has been practiced on a large scale in the Philippines. Although the results of the vaccinations have been apparently very successful from the practical standpoint, no laboratory data are available to demonstrate the immunological properties of the vaccine used. For this reason it was decided to undertake the study reported in this paper in accordance with the modern and apparently more accurate methods of testing the antigenic powers of bacterial organisms.

## MATERIALS AND METHODS

### COMPOSITION OF THE VACCINE

The cholera vaccine prepared by the Philippine Bureau of Science contains 3,000 million killed cholera vibrios per cubic centimeter suspended in physiological salt solution to which 0.5 per cent phenol is added as a preservative. The organism used was isolated several years ago from a fatal case of cholera in Manila and is known under the designation "Cholera strain No. 22."

### BACTERIOLOGICAL STUDY OF CHOLERA STRAIN 22

This organism has been studied by Okamoto and Buñi,(6) who found that it is nonmotile and forms streptococcuslike threads. My findings, however, do not correspond exactly with the observations of these writers. It is true that the organism appears to have lost its motility, but I find that it still retains the typical commalike appearance. In a few instances I have seen streptococcuslike threads in agar cultures, similar to those described by Okamoto and Buñi, but these I consider as involution forms.

When first transplanted from an agar culture the vibrio produces a general turbidity in peptone water, but does not form a pellicle. After several transplantations from peptone water to peptone water, it forms a white pellicle that easily falls to the bottom of the test tube. The organism produces a marked cholera-red reaction. As shown in Table 1 it fermented glucose, maltose, and saccharose, but not mannite. It was agglutinated by anticholera serum up to a dilution of 1 to 400.

TABLE 1.—*Sugar reactions of five strains of cholera vibrio.*

[Readings were made after incubation for twenty-four hours at 37° C.; +++ ++ indicate the relative intensity of the red color.]

| Strain. | Glucose. | Mannite. | Lactose. | Saccharose. | Maltose. | Dulcite. | Xylose. | Russell.[a] |
|---|---|---|---|---|---|---|---|---|
| 18784-1 | +++ | ++ | — | +++ | +++ | — | — | +++ |
| 1930-1 | +++ | +++ | — | +++ | +++ | — | — | +++ |
| 1930-20 | +++ | ++ | — | +++ | +++ | — | — | +++ |
| No. 22 | +++ | — | — | +++ | +++ | — | — | +++ |
| 656-46 | +++ | ++ | — | +++ | +++ | — | — | +++ |

[a] Russell's double sugar medium.

The cholera strain used by the Philippine Bureau of Science in the preparation of vaccine thus differs from other known strains of cholera vibrio in two important respects; it is nonmotile and does not ferment mannite. Whether or not these characteristics were originally possessed by the organism when it was first isolated is not known. By analogy it can only be surmised that it was a motile, mannite-fermenting vibrio but has lost these characters during the long years of its cultivation in artificial media. It would be interesting, therefore, to find out if its antigenic properties have been similarly affected.

## OTHER STRAINS OF CHOLERA VIBRIO USED

In the study of the efficiency of the vaccine in question it is advisable to test it by means of the animal-protection test, not only against the homologous strain of organism used in the preparation of the vaccine but also against as many heterologous strains as are available. Four such strains are in the collection of the Bureau of Science and are designated 18784–1, 1930–1, 1930–20, and 656–46. These were isolated from cholera cases in different parts of the Philippine Islands. Morphologically they appear as short, slightly curved, actively motile spirilla. They ferment glucose, mannite, maltose, and saccharose and all of them give the characteristic cholera red-reaction. They were all agglutinated by anticholera serum in dilutions of 1 to 400 or higher (Table 2).

TABLE 2.—*Agglutination tests on five strains of cholera vibrio.*

[Readings after two hours at 37° C. in incubator and standing twenty-two hours at room temperature (28° to 29° C.).]

| Locality. | Strain. | Dilution. | | | | | | | | | Control. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 | 100 | 200 | 400 | 800 | 1,600 | 3,200 | 6,400 | 12,800 | |
| Iloilo | 18784–1 | ++ | + | + | ± | — | — | — | — | — | — |
| Dumaguete | 1930–1 | ++ | ++ | +++ | +++ | +++ | ++ | + | + | — | — |
| Bulacan | 1930–20 | +++ | +++ | +++ | +++ | +++ | ++ | ++ | + | — | — |
| Manila | No. 22 | +++ | ++ | ++ | + | ± | — | — | — | — | — |
| Cebu | 656–46 | +++ | +++ | +++ | +++ | ++ | ++ | + | + | ± | — |

## PATHOGENICITY TESTS

The minimal lethal dose of each of the various strains of cholera vibrio used in this study was determined by injecting the live organisms intraperitoneally into guinea pigs weighing from 350 to 400 grams. A twenty- to twenty-four-hour alkaline agar culture was used in conducting the test and the same platinum loop was used for measuring the dosage of the inoculum. A suspension of the culture was made in physiological salt solution to contain the desired doses of the inoculum in 1 cc and the inoculated guinea pigs were kept under observation during the succeeding ten days. When the animals died, autopsy was always performed in order to make sure of the cause of death of the animals. In some animals a serofibrinous exudate was found in the peritoneal cavity, while in others the exudate was hæmorrhagic. From such exudates vibrios were isolated using Dieudonne's medium.

The results of the virulence tests are given in Tables 3 to 7, in which it is shown that the minimal lethal dose of strain 18784–1 is one-tenth of a loopful; of strain 22, three loopfuls; of strain 1930–1, three loopfuls; of strain 1930–20, two loopfuls; and of strain 656–46, two loopfuls. It appears from these results that no relation exists between the virulence of an organism and its immunologic properties as indicated by its agglutination reaction. Referring to Table 2, it has been observed that strains 18784–1 and 22 behave in the same manner towards immune serum, the highest agglutinating dilution for both being 1 to 400; and yet the pathogenicity of strain 18784–1 has been found to be about thirty times that of 22. The other three strains agglutinated in dilutions as high as 1 to 6,400 and they showed more or less the same degree of virulence. According to Kabeshima's classification(5) strains 18784–1 and 22 would belong to the so-called "original type" and the other three strains to the "varied type." In this connection it may be asked: Is it a property of the varied types of cholera vibrio to exhibit more or less uniformity in virulence?

TABLE 3.—*Virulence tests on strain 18784–1*

[D12, death within twelve hours after inoculation; S, survived.]

| Date. | Dose. | Guinea pig No.— | | | | | |
|---|---|---|---|---|---|---|---|
| | | 13 | 14 | 15 | 16 | 17 | 18 |
| | *Loopfuls.* | | | | | | |
| November 6 | 2 | D12 | D12 | -------- | -------- | -------- | -------- |
| November 8 | 1 | -------- | -------- | D24 | D24 | -------- | -------- |
| November 8 | $\frac{1}{2}$ | -------- | -------- | -------- | -------- | D24 | D24 |
| November 13 | $\frac{1}{5}$ | -------- | -------- | -------- | -------- | -------- | -------- |
| November 16 | $\frac{1}{10}$ | -------- | -------- | -------- | -------- | -------- | -------- |
| November 20 | $\frac{1}{50}$ | -------- | -------- | -------- | -------- | -------- | -------- |

| Date. | Dose. | Guinea pig No.— | | | | | |
|---|---|---|---|---|---|---|---|
| | | 19 | 20 | 21 | 22 | 23 | 24 |
| | *Loopfuls.* | | | | | | |
| November 6 | 2 | -------- | -------- | -------- | -------- | -------- | -------- |
| November 8 | 1 | -------- | -------- | -------- | -------- | -------- | -------- |
| November 8 | $\frac{1}{2}$ | -------- | -------- | -------- | -------- | -------- | -------- |
| November 13 | $\frac{1}{5}$ | D24 | D24 | -------- | -------- | -------- | -------- |
| November 16 | $\frac{1}{10}$ | -------- | -------- | D24 | D24 | -------- | -------- |
| November 20 | $\frac{1}{50}$ | -------- | -------- | -------- | -------- | S | D36 |

TABLE 4.—*Virulence tests on strain 22.*

[D12, death within twelve hours after inoculation; S, survived.]

| Date. | Dose. | Guinea pig No.— | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | *Loopfuls.* | | | | | | | | | | | | |
| October 11 | ¼ | S | S | | | | | | | | | | |
| October 11 | ⅓ | | | S | S | | | | | | | | |
| October 11 | ½ | | | | | D24 | S | | | | | | |
| October 11 | 1 | | | | | | | S | S | | | | |
| October 30 | 2 | | | | | | | | | D24 | S | | |
| October 30 | 3 | | | | | | | | | | | D12 | D6 |

TABLE 5.—*Virulence tests on strain 1930–1.*

[D12, death within twelve hours after inoculation; S, survived.]

| Date. | Dose. | Guinea pig No.— | | | | | |
|---|---|---|---|---|---|---|---|
| | | 25 | 26 | 27 | 28 | 29 | 30 |
| | *Loopfuls.* | | | | | | |
| November 26 | 1 | D24 | S | | | | |
| December 4 | 2 | | | D12 | S | | |
| December 6 | 3 | | | | | D12 | D12 |

TABLE 6.—*Virulence tests on strain 1930–20.*

[D24, death within twenty-four hours after inoculation; S, survived.]

| Date. | Dose. | Guinea pig No.— | | | |
|---|---|---|---|---|---|
| | | 35 | 36 | 37 | 38 |
| | *Loopfuls.* | | | | |
| December 15 | 1 | S | S | | |
| December 21 | 2 | | | D24 | D24 |

TABLE 7.—*Virulence tests on strain 656–46.*

[D24, death within twenty-four hours after inoculation; S, survived.]

| Date. | Dose. | Guinea pig No.— | | | |
|---|---|---|---|---|---|
| | | 31 | 32 | 33 | 34 |
| | *Loopfuls.* | | | | |
| December 11 | 1 | S | D24 | | |
| December 13 | 2 | | | D24 | D24 |

## METHOD OF IMMUNIZATION

Fifteen guinea pigs were inoculated intraperitoneally June 27, 1934, with Bureau of Science vaccine prepared in the manner already described. Three inoculations were made, using 1 cc for the first and second injections and 1.5 cc for the third injection. The interval between the injections was one week.

## OBSERVATIONS

Of the fifteen guinea pigs that were immunized, ten were selected for the main experiment. These were given intraperitoneally lethal doses of live organisms nine days after receiving the third inoculation of vaccine. Two animals were used for each of the five strains and the doses were regulated in accordance with the results of the virulence tests. The results are shown in Table 8. Of the ten guinea pigs tested only one died; namely, one of those inoculated with strain 1930–1. The rest survived and remained healthy for several months after being inoculated.

These observations prove conclusively that the cholera vaccine prepared by the Philippine Bureau of Science possesses marked antigenic properties and protects against different strains of cholera vibrios. For these reasons the advisability of changing the strain used for the preparation of the vaccine in favor of recently isolated pathogenic strains, as has often been advocated in the case of other bacterial vaccines, does not seem to be warranted. This statement is of course based exclusively on laboratory data, for it is realized that the experiments on which the data are based are not an exact replica of conditions as the latter exist in the human body, it being impossible to infect guinea pigs by giving them cholera vibrios per os.

TABLE 8.—*Protection tests on vaccinated guinea pigs.*

[D24, death within twenty-four hours after inoculation; S, survived.]

| Strain. | Lethal dose. | Guinea pig No.— | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 41 | 42 | 44 | 45 | 46 | 47 | 51 | 52 | 54 | 56 |
| | *Loopfuls.* | | | | | | | | | | |
| 1930–20 | 2 | S | S | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ |
| No. 22 | 3 | ------ | ------ | S | S | ------ | ------ | ------ | ------ | ------ | ------ |
| 656–46 | 2 | ------ | ------ | ------ | ------ | S | S | ------ | ------ | ------ | ------ |
| 1930–1 | 3 | ------ | ------ | ------ | ------ | ------ | ------ | D24 | S | ------ | ------ |
| 18784–1 | $\frac{1}{10}$ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | S | S |

### AGGLUTININ PRODUCTION

Having observed the marked immunizing powers of the Bureau of Science cholera vaccine, I decided to test the agglutinating titer of the serum of the vaccinated guinea pigs for strain 22. For this purpose four of the inoculated animals were bled from the heart and the serum was collected and stored in the refrigerator until ready for use. An emulsion of a twenty-four-hour alkaline agar culture of strain 22 was prepared by adding to the culture 3 cc of physiological salt solution containing 0.5 per cent phenol. Serum dilutions obtained from the guinea pigs were made and distributed in 1-cc amounts in test tubes. One drop of the vibrio emulsion was added to every tube. Controls were set up using normal guinea-pig sera. Readings were made after incubation for two hours at 37° C. and also after standing for twenty-two hours at room temperature (28° to 29° C.). The results are shown in Tables 9 and 10.

TABLE 9.—*Agglutination tests with serum of vaccinated guinea pigs.*

| Guinea pig No.— | Dilution. | | | | | | | | Control. |
|---|---|---|---|---|---|---|---|---|---|
| | 25 | 50 | 100 | 200 | 400 | 800 | 1,600 | 3,200 | |
| 43 | ++ | ++ | +++ | +++ | +++ | ++ | — | — | — |
| 48 | ++ | ++ | +++ | +++ | + | — | — | — | — |
| 53 | ++ | ++ | +++ | ++ | + | — | — | — | — |
| 59 | ++ | ++ | +++ | ++ | + | — | — | — | — |

TABLE 10.—*Agglutination tests with serum of normal guinea pigs.*

| Guinea pig No.— | Dilution. | | | | | Control. |
|---|---|---|---|---|---|---|
| | 25 | 50 | 100 | 200 | 800 | |
| 61 | + | — | — | — | — | — |
| 62 | + | — | — | — | — | — |
| 63 | — | — | — | — | — | — |

The sera of all the vaccinated guinea pigs agglutinated in a dilution of 1 to 400, the serum of guinea pig 43 also agglutinated in 1 to 800 dilution. The sera of only two of the control normal guinea pigs gave agglutination in 1 to 25 dilution, the serum of the third normal guinea pig producing no agglutination in any of the dilutions made. The remarkable agglutinin-producing power of the cholera vaccine is thus evident from these observations.

Tests for agglutinin production were also made on guinea pigs that received intraperitoneally ¼- and 1-loopful doses of live organisms of strain 22. The tests were made ten days after inoculation. Table 11 shows the results obtained.

TABLE 11.—*Agglutination tests with serum of guinea pigs inoculated with live cholera vibrios.*

| Guinea pig No.— | Dose. | Dilution. | | | | | | | Control. |
|---|---|---|---|---|---|---|---|---|---|
| | | 25 | 50 | 100 | 200 | 400 | 800 | 1,600 | |
| | *Loopfuls.* | | | | | | | | |
| 1 | ¼ | ++ | ++ | ++ | + | — | — | — | — |
| 2 | ¼ | ++ | ++ | ++ | + | — | — | — | — |
| 7 | 1 | ++ | ++ | + | — | — | — | — | — |
| 8 | 1 | ++ | ++ | ++ | + | — | — | — | — |

In like manner the agglutinating power of the sera of the guinea pigs that received both cholera vaccine and lethal doses of strain 22 was also determined. The tests were made ten days after the injection of the lethal dose.

The results are given in Table 12.

TABLE 12.—*Agglutination tests with serum of vaccinated guinea pigs that survived lethal doses of live cholera vibrios.*

| Guinea pig No.— | Dilution. | | | | | | | | | | Control. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25 | 50 | 100 | 200 | 400 | 800 | 1,600 | 3,200 | 6,400 | 12,800 | |
| 44 | ++ | ++ | +++ | +++ | +++ | +++ | ++ | + | — | — | — |
| 45 | ++ | ++ | +++ | +++ | ++ | + | + | — | — | — | — |

A comparison of the results obtained, as shown in Tables 9, 11, and 12, brings out the following facts:

(*a*) Agglutinin production in guinea pigs by the intraperitoneal injection of living cholera vibrios is not as marked as when cholera vaccine is inoculated three times intraperitoneally.

(*b*) On the other hand it is very marked when a lethal dose is injected after three doses of cholera vaccine, the agglutinating power of the serum being three to four times as great as when cholera vaccine alone is injected three times.

(*c*) Although the agglutinating power of a serum is not alone responsible for its immune properties, nevertheless, the fact that after inoculation of cholera vaccine the agglutinating titer rose to as much as five or six times the normal titer and the fact that the large majority of the vaccinated animals survived lethal doses of live cholera vibrios make it reasonable to suppose that agglutinins play no mean rôle in determining resistance against the live organisms.

## SUMMARY AND CONCLUSIONS

1. The cholera vibrio (strain 22) used in the preparation of the cholera vaccine by the Bureau of Science possesses two characteristics which render it unique; namely, inability to ferment mannite and nonmotility.
2. The Bureau of Science cholera vaccine was shown by laboratory tests to possess marked antigenic powers and to protect effectively against various strains of cholera vibrio.
3. No relation was found between the virulence and the immunological group of cholera vibrio. In a given group some strains are very virulent, while others are very weak.

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# NITRIFICATION IN ACID SOILS

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The acidity of soils in relation to the activities of nitrifying organisms is a problem of vital importance because of its direct bearing upon the crop-producing power of the land.

This report gives the results of an investigation on the nitrification (nitrate production) in acid soils.

A number of researches have been carried out to determine the conditions responsible for this particular kind of nitrification.(1-12) Theoretically nitrification processes can only take place in a neutral or alkaline medium under controlled conditions. However, it is not uncommon to find nitrate production occurring in acid soils. For example, Temple(21) reported that nitrification was active in a soil which had a lime requirement of 5,000 pounds per acre.

Some of the European workers who have observed nitrification in a distinctly acid soil claim that there exists in the soil a strain or strains of nitrifying acid-resisting bacteria. Others claim that the organisms concerned in the process of nitrification can be made to grow in media of different reactions by gradual adaptation.

## EXPERIMENTAL PROCEDURE

*The effect of acidity on nitrifying soil organisms.*—Experiments were first carried out to ascertain the critical acid concentration that would inhibit the activity of nitrifying organisms in the soil.

The soil used was a brown silt loam with very low lime requirement (0.009 per cent equivalent calcium carbonate) as determined by Hopkins's method for soil acidity.(14)

The experiments were made in series, each of which represented certain acid concentrations. For each series there were twelve cultures of treated soil contained in Erlenmeyer flasks. In each flask there was a quantity of soil that was equivalent to 100 grams of water-free soil. This was treated with dilute sulphuric acid to obtain the percentage of acidity desired. The soil and acid were thoroughly mixed and set aside for one week to insure as complete diffusion of acid in the soil as possible. Ammonium sulphate (0.2 gram) was then mixed with the acidified soil and enough water was added to get a moisture content of 60 per cent. The cultures were incubated for twenty-eight days at ordinary tropical room temperature (25° to 30° C.). The water content of the soil was kept constant during the period of incubation. After incubation nitrate-nitrogen determinations were made for ten cultures of each series using the modified phenol disulphonic method.(13, 17) The remaining two cultures were used for soil acidity determinations, employing Hopkins's method. The results of the experiments (Table 1) represent the average for each series.

TABLE 1.—*Effect of different concentrations of acid on the activity of nitrifying organisms in the soil.*

| Series. | Nitrate nitrogen per 100 g of soil. | | Added nitrogen nitrified. | Acid. | |
|---|---|---|---|---|---|
| | Control soil. | Soil treated with 0.2 g ammonium sulphate. | | At the beginning. | After 28 days. |
| | *mg.* | *mg.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 1 | Nil. | Nil. | Nil. | 1.71 | 1.00 |
| 2 | Trace. | Trace. | Trace. | 0.80 | 0.53 |
| 3 | 0.015 | 0.315 | 0.71 | 0.60 | 0.20 |
| 4 | 0.014 | 0.29 | 0.66 | 0.40 | 0.06 |
| 5 | 0.192 | 4.00 | 9.06 | 0.20 | 0.02 |
| 6 | 0.760 | 15.94 | 36.14 | 0.08 | 0.015 |
| 7 | 1.120 | 23.46 | 53.19 | 0.06 | 0.013 |
| 8 | 1.330 | 27.93 | 63.33 | 0.04 | 0.011 |
| 9 | 1.700 | 36.00 | 81.66 | 0.02 | 0.008 |
| 10 | 1.904 | 40.00 | 90.70 | 0.009 | 0.005 |

The results (Table 1) show that there was only a slight degree of nitrification in a soil having 0.8 per cent acidity, but as the acidity decreased the nitrate production increased. For a medium with 1.71 per cent acid there was no nitrification. The medium, having 0.009 per cent acid, converted into nitrate 90.70 per cent of the nitrogen added.

These data also bring out the fact that the initial acidity did not remain constant during the course of the experiments but was reduced.

*Activity of nitrifying bacteria grown in nutrient solutions of different acid concentrations.*—Preliminary experiments showed that a satisfactory medium was obtained by simply using water and ammonium sulphate. Erlenmeyer flasks (300-cc capacity) were used as containers. Distilled water (100 cc) was poured into each flask and 0.1 gram of ammonium sulphate was added. The culture solution was neutralized with dilute sodium hydroxide and the desired acidity established with dilute sulphuric acid. The reactions were made to range from pH 2.0 to pH 8.8. The alkaline reaction (pH 8.8) was obtained by the addition of calcium carbonate. Duplicate cultures were made for each reaction. One gram of fresh garden soil of sandy type and having only traces of carbonates was added to each culture solution. The cultures were incubated for twenty-eight days at ordinary room temperature (25 ° to 30 ° C.), and the concentration in each flask was maintained by adding distilled water from time to time. The cultures were then analyzed for nitrates and acidity. The pH determinations were made by the electrometric method using the antimony electrode. The results are presented in Table 2.

TABLE 2.—*Activity of nitrifying bacteria grown in nutrient solutions of different acid concentrations.*

| Series. | pH value. | Nitrate nitrogen.[a] | Added nitrogen. nitrified. | Series. | pH value. | Nitrate nitrogen.[a] | Added nitrogen. nitrified. |
|---|---|---|---|---|---|---|---|
| | | *mg.* | *Per cent.* | | | *mg.* | *Per cent.* |
| 12 | 2.0 | Nil. | Nil. | 29 | 3.8 | Nil. | Nil. |
| 13 | 2.0 | Nil. | Nil. | 30 | 4.4 | Nil. | Nil. |
| 14 | 2.6 | Nil. | Nil. | 31 | 4.4 | Nil. | Nil. |
| 15 | 2.6 | Nil. | Nil. | 32 | 4.8 | Nil. | Nil. |
| 16 | 2.9 | Nil. | Nil. | 33 | 4.8 | Nil. | Nil. |
| 17 | 2.9 | Nil. | Nil. | 34 | 5.2 | Nil. | Nil. |
| 20 | 3.2 | Nil. | Nil. | 35 | 5.2 | Nil. | Nil. |
| 21 | 3.2 | Nil. | Nil. | 36 | 6.6 | Trace. | Trace. |
| 26 | 3.6 | Nil. | Nil. | 37 | 6.6 | Trace. | Trace. |
| 27 | 3.6 | Nil. | Nil. | 38 | 7.0 | 0.40 | 1.90 |
| 28 | 3.8 | Nil. | Nil. | 39 | 8.8 | 4.44 | 21.14 |

[a] After addition of 0.1 g of ammonium sulphate.

The data (Table 2) show that only a slight amount of nitrate was obtained in cultures that had an acid reaction of pH 6.6 and no nitrates were found in cultures of greater acidity. Cultures having reactions ranging from neutral to alkaline produced a much larger amount of nitrates. The highest nitrate production occurred in cultures in which calcium carbonate was added. The reaction of these cultures was pH 8.8, and the nitrate nitrogen with this reaction was 21.14 per cent of the added nitrogen. These results indicated that nitrification processes proceeded very slowly in a medium having a slight acid reaction.

*The influence of carbonates on the activitity of nitrifying bacteria in acid soils.*—These experiments aimed to ascertain the effect of carbonates on the activity of the nitrifying bacteria in acid soils.

The soil employed was a brown silt loam with a very low lime requirement—0.005 per cent calcium carbonate equivalent per hectare as determined by Hopkins's method for soil acidity. These experiments were made in series, each of which consisted of thirteen separate cultures of 100 grams (computed on a water-free basis). Each soil culture was placed in an Erlenmeyer flask of 300-cc capacity. Each series represented a certain acid concentration ranging from 0.005 to 5.0 per cent. The acidity was established by the addition of sulphuric acid to the soil. After the acid was added the soil was stirred thoroughly to obtain a uniform mixture. The acidified soil cultures were set aside overnight, after which 0.2 gram of ammonium sulphate was added to the contents of each flask. All cultures were adjusted to contain 60 per cent moisture and were incubated for twenty-eight days at ordinary room temperature. The moisture content was kept constant during the period of incubation. The cultures were then analyzed as follows: Ten for nitrate nitrogen, two for acidity, and the remainder for carbonate carbon by Parr's method.(19)

As shown by the results (Table 3) cultures that had from 1 to 5 per cent of acid contained no carbonates and also had no nitrates. Cultures with acid concentrations ranging from 0.9 to 0.005 per cent contained both carbonates and nitrates, but the amounts were inversely proportional to the acid content. After twenty-eight days' incubation the cultures that had carbonates gave nitrate nitrogen upon analysis. The amount of nitrate for each culture was in direct proportion to the carbonate content of the soil. The experiments show that, within certain limits, both carbonates and acid can exist in the soil at the same time and that the amount of carbonate remaining depends upon the amount of acid present. Furthermore, whenever a quantity of carbonate is present nitrification processes can take place until the last trace of carbonate is removed.

TABLE 3.—*Influence of carbonates on the activity of nitrifying bacteria in acid soils.*

| Series. | Acid (in terms of $H_2SO_4$). | Carbonate carbon in the soil. | Nitrate nitrogen per 100 g of soil. | | Added nitrogen nitrified. |
|---|---|---|---|---|---|
| | | | Control soil. | Soil treated with 0.2 g ammonium sulphate. | |
| | *Per cent.* | *Per cent.* | *mg.* | *mg.* | *Per cent.* |
| 40 | 5.00 | Nil. | Nil. | Nil. | Nil. |
| 41 | 4.00 | Nil. | Nil. | Nil. | Nil. |
| 42 | 3.00 | Nil. | Nil. | Nil | Nil. |
| 43 | 2.00 | Nil. | Nil. | Nil. | Nil. |
| 44 | 1.00 | Nil. | Nil. | Nil. | Nil. |
| 45 | 0.90 | 0.0045 | Trace. | Trace. | Trace. |
| 46 | 0.80 | 0.0036 | 0.0160 | 0.121 | 0.25 |
| 47 | 0.70 | 0.0073 | 0.0224 | 0.182 | 0.38 |
| 48 | 0.60 | 0.0127 | 0.0250 | 0.227 | 0.48 |
| 49 | 0.50 | 0.0128 | 0.0320 | 0.284 | 0.60 |
| 50 | 0.40 | 0.0143 | 0.0365 | 0.331 | 0.70 |
| 51 | 0.30 | 0.0140 | 0.0360 | 0.348 | 0.74 |
| 52 | 0.20 | 0.0127 | 0.0410 | 2.309 | 5.40 |
| 53 | 0.10 | 0.0146 | 0.0540 | 2.343 | 5.45 |
| 54 | 0.09 | 0.0163 | 0.1366 | 9.301 | 21.82 |
| 55 | 0.08 | 0.0164 | 0.2044 | 13.930 | 32.63 |
| 56 | 0.07 | 0.0164 | 0.2078 | 13.106 | 30.71 |
| 57 | 0.06 | 0.0173 | 0.2864 | 18.149 | 42.53 |
| 58 | 0.05 | 0.0173 | 0.6254 | 20.105 | 46.34 |
| 59 | 0.04 | 0.0173 | 0.2450 | 14.105 | 33.00 |
| 60 | 0.03 | 0.0173 | 0.3230 | 18.740 | 43.85 |
| 61 | 0.005 | 0.0192 | 0.7984 | 21.055 | 48.23 |

The soil is a heterogenous mixture of inorganic and organic constituents. An average sample may have an acid reaction, although some particles may contain carbonates not yet acted upon by the acid present. It would seem that the nitrification process, as observed in acid soils, actually takes place in those soil particles containing a considerable amount of carbonates. Perhaps this will explain the apparent inconsistency of nitrification in acid soils.

## SUMMARY

The results obtained in this investigation confirmed the findings of others that nitrification may occur in acid soils (Table 1). It was found that an acid concentration of 0.5 to 1.0 per

cent in the soil inhibits the activity of nitrifying bacteria. Nitrate production was highest in cultures containing the lowest acid concentration. In a culture containing 0.005 per cent acid, over 90 per cent of the nitrogen added was converted into nitrate nitrogen.

When nitrification tests were conducted in a nutrient solution, nitrate production was not obtained in all cultures having an acid reaction. Again, in cultures of neutral reaction only a very slight degree of nitrification was observed. Normal production of nitrate occurred when calcium carbonate was added to neutral cultures.

It was found that both acid and carbonate radicals can exist at the same time in an acid soil and that, under these conditions, a certain degree of nitrification can take place depending upon the amount of carbonates present.

Summarizing the results of these experiments it would seem that nitrification processes can take place in an acid soil if carbonates are present. The occurrence of nitrification in acid soils would appear to be due to the presence of carbonates.

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# PHILIPPINE GINGER IN RELATION TO THE UNITED STATES FOOD AND DRUGS ACT

By JOAQUIN MARAÑON and ELENA CAGUICLA
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TWO PLATES

A considerable amount of ginger root is imported into the United States. In 1931 the imports amounted to 5,059,184 pounds valued at 563,228 pesos.[1] The Philippine Bureau of Commerce and Industry has been receiving letters[2] from prominent dealers inquiring as to the quality of ginger grown in the Philippines. Very likely the production of Philippine ginger could be developed into a profitable industry provided a satisfactory product can be produced.

This investigation was undertaken primarily to ascertain if Philippine ginger conforms to the requirement for ginger imported into the United States.

From early times ginger (*Zingiber officinale* Roscoe) has been known for its medicinal properties as a carminative and stimulant. There are many pharmaceutical preparations containing ginger and these are official in the various pharmacopœias. Because of its aromatic and pleasantly pungent taste it is used extensively as a spice and also as a flavoring agent in the manufacture of soft drinks. The young and tender ginger rhizomes are made into confectionery and condiments (preserved ginger).

Ginger is widely cultivated in small lots throughout the Philippines, but it has never been planted on a large scale. It has been estimated that the yield of ginger roots under Philippine conditions is about 1,000 to 1,700 kilos per hectare.[3] There are two varieties grown locally (Plates 1 and 2). One is known as the Hawaiian and the other as the native (Philippine) variety. The Hawaiian variety has a larger rhizome than the native variety but, when fresh, it is less pungent. There are, however, grades between these two varieties.

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[1] Foreign Commerce and Navigation of the United States (1931) 421.

[2] Rivera, P., Comm. and Ind. Journ. (Philippines) 6 (1930) 9.

[3] Philippine Bureau of Agriculture Circular No. 142 (1924).

Investigations of Philippine ginger have been made by Bacon,[4] Adriano and Tavanlar,[5] and Valenzuela.[6]

Bacon found that the light yellow oil obtained by distillation from two lots of Philippine ginger roots differs quite markedly in its properties from that distilled from Jamaica or African varieties. The oil from Philippine ginger is readily soluble in 90 per cent alcohol and has a negative rotation. In this respect it resembles some Japanese ginger oils examined by Schimmel and Company. Bacon also determined the physical constants of the oil and quoted Zimmermann[7] concerning the cultivation and preparation of ginger.

In their report on the calcium oxide content of Philippine foods Adriano and Tavanlar stated that the ash of Philippine ginger contains 1.27 per cent calcium oxide corresponding to 0.05 per cent based on the dried sample.

Valenzuela made histological and phytochemical studies of Philippine ginger and concluded that the local product has the general characteristic properties of foreign commercial varieties. In his investigation considerable attention was directed to the chemical composition and properties of the volatile and fatty oils found in Philippine ginger. He also studied the morphological characteristics of the different tissues comprising the ginger rhizome and the distribution of the pungent principles in these tissues.

## EXPERIMENTAL PROCEDURE

Fresh rhizomes from ginger grown locally were used for our experiments. Twelve samples were purchased in the Manila markets during January, February, and March, 1935. Two other samples, that were kindly presented to us by Dr. N. B. Mendiola, were obtained from plants cultivated at the experiment station of the College of Agriculture, University of the Philippines.

The ginger roots were washed thoroughly to remove adhering particles of soil and other foreign matter. The clean rhizomes were cut into small pieces that were sun-dried and then ground into a fine powder.

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[4] Philip. Journ. Sci. § A 5 (1910) 259.

[5] Philip. Agr. 14 (1925) 347.

[6] Journ. Am. Pharm. Assoc. 15 (1926) Nos. 8 and 9.

[7] Communications from the Biologico-Agricultural Institute, Amari, Reprint from Usumbara Post (1904) No. 28.

In analyzing the ginger samples we followed the usual official methods for spices and other condiments.[8]

In Table 1 are given data for the requirements of ginger imported into the United States.

TABLE 1.—*Standard requirements for dried ginger roots according to the United States Food and Drugs Act.*[a]

| Constituent. | Per cent. |
|---|---|
| Starch | 42 or more. |
| Crude fiber | 8 or less. |
| Lime (CaO) | 1 or less. |
| Cold-water extract | 12 or more. |
| Total ash | 7 or less. |
| Ash insoluble in hydrochloric acid | 2 or less. |
| Ash soluble in cold water | 2 or more. |

[a] Dunn's Food and Drug Laws 1 (1927–1928) 132.

The results of analyzing some samples of Philippine ginger are recorded in Table 2. As shown by the data these samples conformed to the requirements for ginger imported into the United States (Table 1).

TABLE 2.—*Analyses of Philippine ginger samples that conform to the United States standard.*

| Sample No. | Variety. | Moisture. | Ether extract. | Alcoholic extract. | Cold-water extract. | Crude fiber. |
|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 4 | Native | 12.81 | 7.99 | 9.30 | 15.61 | 5.00 |
| 5 | Hawaiian | 7.81 | 8.91 | 8.84 | 21.06 | 5.37 |
| 6 | Intermediate [a] | 6.76 | 9.05 | 7.48 | 24.80 | 3.63 |
| 8 | Hawaiian | 9.11 | 10.56 | 11.24 | 13.63 | 7.26 |
| 12 | Native | 7.81 | 9.61 | 9.63 | 16.49 | 6.04 |

| Sample No. | Variety. | Starch. | Calcium oxide. | Ash. | | |
|---|---|---|---|---|---|---|
| | | | | Total. | Soluble in water. | Insoluble in HCl. |
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 4 | Native | 43.22 | 0.32 | 6.17 | 5.55 | 1.04 |
| 5 | Hawaiian | 47.11 | 0.32 | 6.36 | 5.99 | 0.51 |
| 6 | Intermediate [a] | 49.49 | 0.34 | 6.56 | 5.49 | 0.61 |
| 8 | Hawaiian | 42.81 | 0.32 | 5.81 | 5.79 | 0.30 |
| 12 | Native | 48.86 | 0.17 | 6.23 | 4.89 | 0.10 |

[a] Intermediate between Hawaiian and native varieties.

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[8] Methods of Analysis of the Association of Official Agricultural Chemists, 3d ed. (1930) 349.

Other samples of ginger that we analyzed (Table 3) did not exactly conform to the United States standard. Some had less than the required amount of starch (42 per cent), while others contained more than the maximum quantity allowed for ash (7 per cent). As far as other constituents are concerned these samples were satisfactory for export.

TABLE 3.—*Analyses of Philippine ginger samples that do not conform exactly to the United States standard.*

| Sample No. | Variety. | Moisture. | Ether extract. | Alcoholic extract. | Cold-water extract. | Crude fiber. |
|---|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 1 | Hawaiian | 7.67 | 8.69 | 12.60 | 17.96 | 4.34 |
| 2 | Do. | 7.04 | 6.77 | 9.81 | 16.70 | 4.77 |
| 3 | Intermediate. | 8.10 | 10.13 | 10.27 | 18.56 | 4.93 |
| 4A | Native | 8.34 | 7.60 | 9.71 | 17.70 | 6.23 |
| 7 | Do | 5.86 | 7.47 | 6.30 | 22.62 | 4.64 |
| 9 | Hawaiian [a] | 9.26 | 9.32 | 9.99 | 18.11 | 6.31 |
| 10 | Intermediate [a] | 11.18 | 8.07 | 8.58 | 18.24 | 7.60 |
| 11 | Native [a]. | 12.87 | 9.76 | 7.08 | 19.35 | 6.91 |
| 13 | Hawaiian. | 6.49 | 8.54 | 11.39 | 18.20 | 7.20 |

| Sample No. | Variety. | Starch. | Calcium oxide. | Ash. | | |
|---|---|---|---|---|---|---|
| | | | | Total. | Soluble in water. | Insoluble in HCl. |
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 1 | Hawaiian | 39.21 | 0.26 | 7.64 | 6.29 | 0.16 |
| 2 | Do. | 41.19 | 0.31 | 9.82 | 9.02 | 0.60 |
| 3 | Intermediate | 40.93 | 0.33 | 9.59 | 8.49 | 1.13 |
| 4A | Native | 41.15 | 0.37 | 8.44 | 7.21 | 1.23 |
| 7 | Do. | 50.93 | 0.35 | 8.23 | 7.18 | 1.09 |
| 9 | Hawaiian[a] | 42.11 | 0.12 | 8.81 | 7.94 | 0.58 |
| 10 | Intermediate[a] | 44.26 | 0.34 | 8.41 | 5.26 | 0.52 |
| 11 | Native [a]. | 42.11 | 0.35 | 8.78 | 7.48 | 0.26 |
| 13 | Hawaiian | 48.06 | 0.32 | 9.56 | 8.38 | 0.12 |

[a] Analyzed by Miss Luz Cosme, Bureau of Science.

It would seem that ginger is rather variable in composition. Samples of foreign ginger, like the local product, show decided differences in analysis. The data (Table 4) indicate that the local ginger is somewhat superior to foreign ginger in that it has a larger amount of extractives and water-soluble ash.

TABLE 4.—*Comparative average analyses of Philippine and foreign ginger.*

| Constituent. | Ginger. | | | | | |
|---|---|---|---|---|---|---|
| | Philippine. | | | Foreign.[a] | | |
| | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. |
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Moisture | 12.87 | 5.86 | 8.65 | 11.72 | 8.71 | 10.44 |
| Alcohol extract | 12.60 | 6.30 | 9.40 | 6.58 | 3.63 | 5.18 |
| Ether extract | 10.56 | 6.77 | 8.74 | 8.51 | 3.78 | 6.07 |
| Cold-water extract | 24.80 | 13.63 | 18.50 | 17.55 | 10.92 | 13.42 |
| Crude fiber | 7.60 | 3.63 | 5.73 | 5.50 | 2.37 | 3.91 |
| Starch | 50.93 | 39.21 | 44.24 | 60.31 | 49.05 | 54.53 |
| Calcium oxide | 0.37 | 0.26 | 0.30 | 3.53 | 0.20 | 0.80 |
| Ash: | | | | | | |
| Total | 9.82 | 5.81 | 7.88 | 9.35 | 3.61 | 5.27 |
| Soluble in water | 9.02 | 4.89 | 6.78 | 4.09 | 2.29 | 2.71 |
| Insoluble in HCl | 1.23 | 0.10 | 0.59 | 2.29 | 0.02 | 0.44 |

[a] Leach, A. E., and A. L. Winton, Food Inspection and Analysis (1920) 463.

It is known that the chemical composition of plants is affected by the environmental conditions under which the plants are grown. It is, therefore, not surprising to find that some samples of Philippine ginger fall somewhat below the standard required by the United States Food and Drugs Act. Careful selection of root stock and proper cultivation would very likely yield a grade of ginger entirely satisfactory for export.

## SUMMARY

Samples of Philippine ginger roots were analyzed to ascertain if this local product conforms to the requirements for ginger imported into the United States.

Some samples were found to be satisfactory for export, while others did not exactly meet the standard requirements for starch and total ash.

Careful selection of root stock and proper cultivation would very likely yield a grade of ginger entirely satisfactory for export purposes.

# ILLUSTRATIONS

## PLATE 1

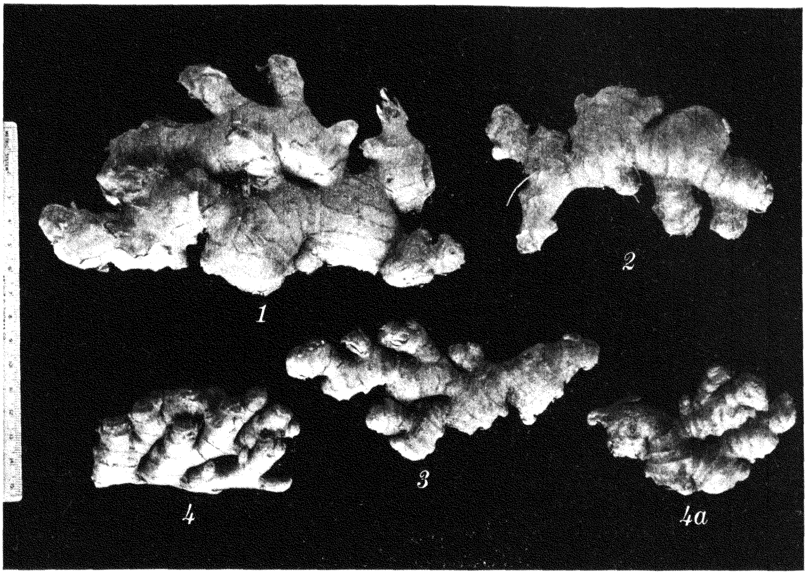
Representative samples of fresh rhizomes of ginger grown in the Philippines and purchased in Manila markets.

Sample 1. Hawaiian variety.
2. Hawaiian variety.
3. Intermediate between Hawaiian and native varieties.
4. Native variety.
4A. Native variety.
5. Hawaiian variety.
6. Intermediate between Hawaiian and native varieties.
7. Native variety.

## PLATE 2

Samples of the fresh rhizomes of ginger grown at the experimental station, College of Agriculture, University of the Philippines, Los Baños, Laguna.

Sample 12. Native variety.
13. Hawaiian variety.



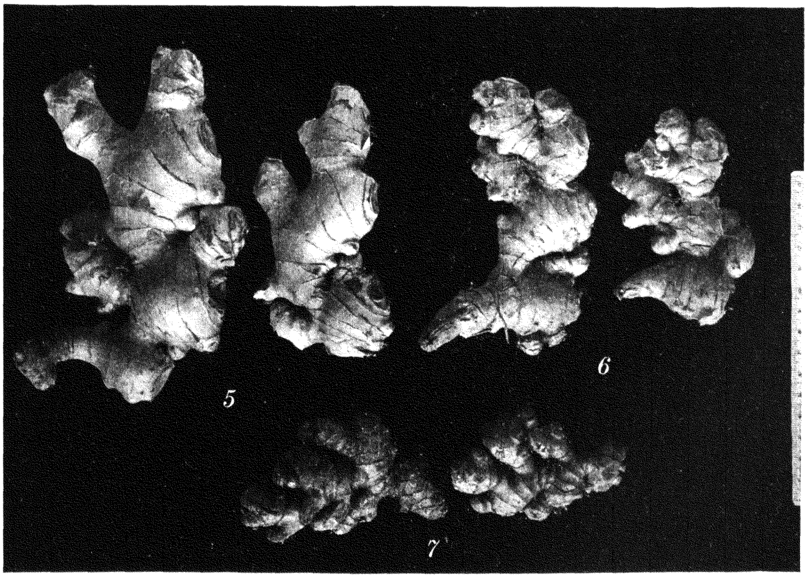


PLATE 1.

UNIV. OF MICH.

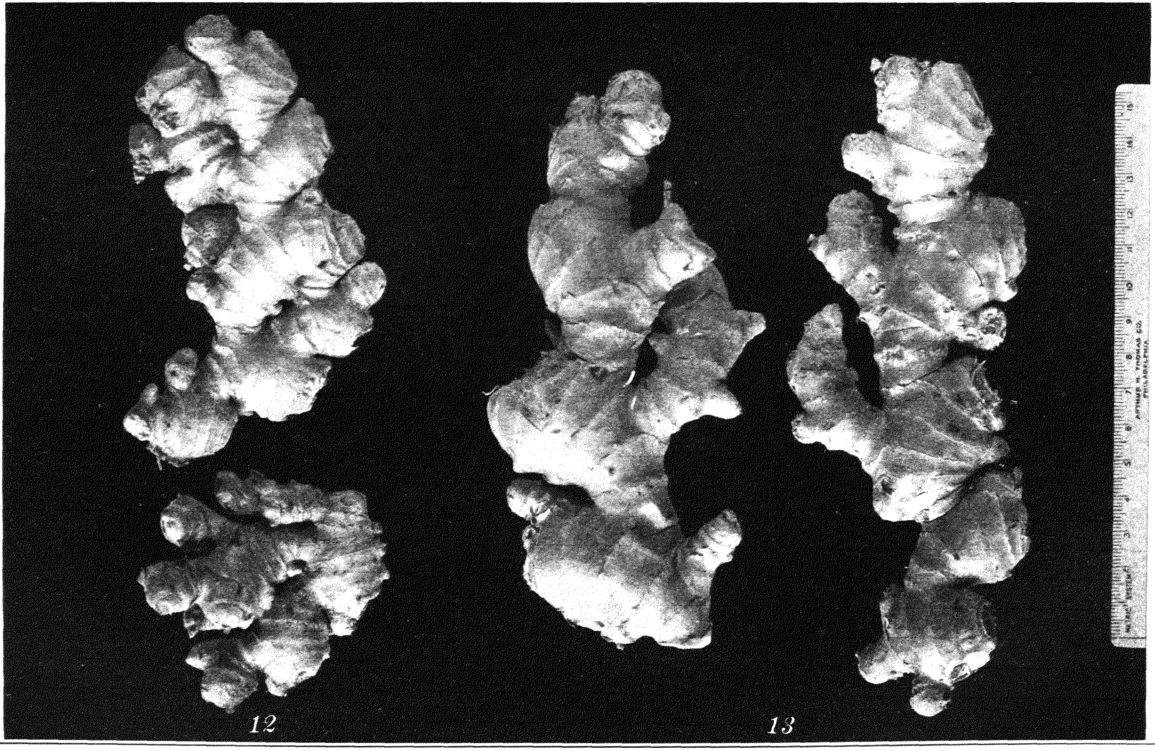


PLATE 2.

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# DIATOMS FROM CALCUTTA, INDIA

By B. W. SKVORTZOW
*Of Harbin, Manchoukuo*

ONE PLATE

Through the kindness of Prof. Dr. S. R. Bose, of the Carmichael Medical College, Calcutta, India, I have been enabled to examine two samples of diatoms, collected in Calcutta. Sample 1 is from mosses and algæ from tree bark, dated February 15, 1926; sample 2 is mud from a channel.

The first list of Calcutta diatoms is given by C. G. Ehrenberg.[1] He examined the earth from Calcutta Botanical Garden and the mud from a lake of Tank-Square, collected by Dr. Philippi in 1845.

Nearly all diatoms listed by Ehrenberg are of cosmopolitan nature, as follows:

*Amphora gracilis.*
*Amphora libyca.*
*Cocconeis placentula.*
*Cocconema lupula.*
*Coscinodiscus argus.*
*Coscinodiscus centralis.*
*Coscinodiscus heteroporus.*
*Coscinodiscus subtilis.*
*Fragilaria acuta.*
*Fragilaria pinnata.*
*Gallionella aurichalcea.*
*Gallionella distans.*
*Gallionella granulata.*
*Gallionella laevis.*
*Gallionella procera.*
*Gallionella tenerrima.*
*Gomphonema clavatum.*
*Gomphonema gracile.*
*Pinnularia borealis.*
*Pinnularia viridula.*
*Surirella bifrons.*
*Synedra curvata.*
*Synedra entomon.*
*Synedra ulna.*

Professor Bose's collections are of great interest. The material is sufficiently rich in diatoms, especially small forms, half of which are new. The sample from mosses, No. 1, is rich in aerophytic species, especially—

*Melosira roeseana* var. *indica.*
*Stauroneis calcuttensis.*
*Navicula microcephala.*
*Navicula insociabilis.*
*Navicula seminulum.*
*Navicula pseudoseminulum.*
*Navicula boseana.*
*Navicula medica.*
*Pinnularia calcutta.*
*Amphora normani.*
*Hantzschia amphioxys.*
*Nitzschia communis.*
*Nitzschia frustulum.*
*Nitzschia microcephala.*

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[1] Mikrogeologie 124–127.

The sample from a channel, No. 2, contains fresh- and brackish-water forms, especially—

*Diploneis puella.*
*Navicula cuspidata.*
*Navicula cryptocephala.*
*Navicula pygmaea* var. *indica.*
*Navicula capitellata.*
*Navicula budda.*
*Navicula calcuttensis.*
*Amphora normani.*
*Amphora veneta.*
*Amphora coffeaeformis.*
*Rhopalodia gibberula.*
*Nitzschia obtusa.*
*Nitzschia thermalis.*
*Nitzschia commutata.*
*Nitzschia palea.*
*Nitzschia vermica.*
*Nitzschia fonticola.*
*Nitzschia amphibia.*
*Nitzschia frustulum.*
*Nitzschia filiformis.*

Two samples yielded fifty-six forms, a list of which is given below. The diatoms were examined with apochromat 2 mm of E. Leitz and compens. oculars No. 6, 8, and 12. The note is illustrated with drawings (Plate 1) by the author, and the number after each species, in the text, corresponds to the locality from which it was obtained.

### MELOSIRA ROESEANA Rabh. var. INDICA var. nov. Plate 1, fig. 1.

Valve circular with large marginal costæ, passing to the puncta zone. Center hyaline with one or two large puncta. Diameter, 0.035 mm. Costæ 14 in 0.01 mm. Not common. Sample 1.

### ACHNANTHES EXIGUA Grun. Plate 1, fig. 2.

*Achnanthes exigua* Grun., F. HUSTEDT, Bacillar. (1930) 201, fig. 286.

Valve broad-lanceolate with truncate ends. Length, 0.012 mm; breadth, 0.0042 mm. Striæ 24 in 0.01 mm. Central areas a broad stauros. A fresh-water species. Not common. Sample 2.

### ACHNANTHES EXIGUA Grun. var. INDICA var. nov. Plate 1, fig. 3.

Valve slightly siliceous, small and short. Length, 0.006 mm; breadth, 0.0034. Striæ 24 in 0.01 mm. Common. Sample 1.

### DIPLONEIS PUELLA (Schumann) Cleve. Plate 1, fig. 4.

*Diploneis puella* (Schumann) CLEVE, F. HUSTEDT, Bacillar. (1930) 250, fig. 394.

Valve elliptical-lanceolate with broad ends. Length, 0.007 mm; breadth 0.0085. Axial areas lanceolate. Striæ 15 in 0.01 mm, radiate. A brackish-water diatom. Not common. Sample 2.

**STAURONEIS CALCUTTENSIS** sp. nov. Plate 1, figs. 5 and 6.

Valve linear-lanceolate with parallel margins, narrowed towards the ends. Length, 0.015 to 0.022 mm; breadth, 0.0034 to 0.004. Ends subrostrate, rounded. The truncate part of the ends divided by a band. Median line straight, axial areas narrow and indistinct. Central areas a broad stauros, widened and truncate outwards. Striæ 18 to 24 in 0.01 mm, slightly radiate, shortened in the middle part. This species is akin to *Stauroneis parvula* Grun. Common. Sample 1.

**STAURONEIS PARVULA** Grun. var. **LANCEOLATA** var. nov. Plate 1, fig. 7.

Valve strongly linear with narrowed ends. Length, 0.018 mm; breadth, 0.0034. Striæ 24 in 0.01 mm, forming in the middle part a broad stauros widened to the margins.

**NAVICULA CUSPIDATA** Kutz. var. **AMBIGUA** (Ehr.) Cleve. Plate 1, fig. 8.

*Navicula cuspidata* Kutz. var. *ambigua* (Ehr.) Cleve, F. HUSTEDT, Bacillar. (1930) 268, fig. 434.

Valve lanceolate with rostrate-capitate ends. Length, 0.074 mm; breadth, 0.018. A fresh-water species. Common. Sample 2.

**NAVICULA VIRIDULA** Kutz. **CALCUTTENSIS** var. nov. Plate 1, fig. 9.

Valve linear-elliptical, narrowed towards the ends. Ends broad, rounded. Length, 0.024 mm; breadth, 0.007. Striæ divergent in the middle, convergent at the ends, 12 to 14 in 0.01 mm. Axial area very narrow, central areas small, slightly transversely dilated. Not common. Sample 2.

**NAVICULA MENISCULUS** Schumann. Plate 1, fig. 10.

*Navicula menisculus* Schumann, VAN HEURCK, Synopsis (1880–81) pl. 8, figs. 21, 22.

Valve broad-lanceolate with truncate rounded ends. Length, 0.018 mm; breadth, 0.006. Striæ radiate, 15 in 0.01 mm. Not common. Sample 2.

**NAVICULA CRYPTOCEPHALA** Kutz. Plate 1, fig. 11.

*Navicula cryptocephala* Kutz., F. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate with subacuminate rounded ends. Length, 0.022 to 0.028 mm; breadth, 0.005 to 0.0068. Striæ radiate, 15 to 18 in 0.01 mm. Common. Sample 2.

**NAVICULA CRYPTOCEPHALA** Kutz. var. **VENETA** Kutz. Plate 1, fig. 12.

*Navicula cryptocephala* Kutz. var. *veneta* Kutz., VAN HEURCK, Synopsis (1880-81) pl. 8, figs. 3, 4.

Valve lanceolate, narrowed towards the ends. Length, 0.017 to 0.018 mm; breadth, 0.005 to 0.0068. A brackish-water diatom. Common. Sample 2.

**NAVICULA MICROCEPHALA** Grun. Plate 1, fig. 13.

*Navicula microcephala* Grun., F. HUSTEDT, Bacillar. (1930) 289, fig. 491.

Valve slightly siliceous, lanceolate, with obtuse ends. Length, 0.01 mm; breadth, 0.0025. Areas indistinct. Striæ very fine, about 30 in 0.01 mm. A fresh-water diatom known from all parts of the world. Common. Sample 1.

**NAVICULA PYGMAEA** Kutz. var. **INDICA** var. nov. Plate 1, fig. 14.

Valve elliptical with obtuse ends. Lateral areas convergent and constricted in the middle. Length, 0.02 to 0.024 mm; breadth, 0.0085 to 0.01. Striæ fine, about 24 in 0.01 mm. As in the type, but with broader ends. *Navicula pygmaea* is known in brackish waters of Europe, northern Siberia, and South America. Common. Sample 2.

**NAVICULA INSOCIABILIS** Krasske. Plate 1, fig. 15.

*Navicula insociabilis* KRASSKE, Beiträge zur Ken. der Diatom. der Alpen (1932) 114, pl. fig. 17.

Valve lanceolate, narrowed towards the ends, truncate. Length, 0.015 to 0.017 mm; breadth, 0.006. Axial area very narrow. Central area slightly transversely dilated. Striæ slightly radiate, 21 in 0.01 mm. Known from Europe in mosses and on wet rocks. Common on the bark of trees in Calcutta. Sample 1.

**NAVICULA INSOCIABILIS** Krasske var. **LANCEOLATA** var. nov. Plate 1, fig. 16.

Valve lanceolate, more narrowed towards the ends. Length, 0.017 to 0.019 mm; breadth, 0.005 to 0.006. Striæ 18 in 0.01 mm. This variety differs from the type by its more elongate valves. Very common. Sample 1.

**NAVICULA SEMINULUM** Grun. Plate 1, fig. 17.

*Navicula seminulum* Grun., VAN HEURCK, Synopsis (1880-81) pl. 14, fig. 10.

Valve lanceolate with truncate ends. Length, 0.017 mm; breadth, 0.005. Striæ 20 in 0.01 mm, radiate, not crossed by longitudinal bands. This species resembles *Navicula pseudoseminulum* sp. nov. Common in mosses from Calcutta. Sample 1.

**NAVICULA PSEUDOSEMINULUM sp nov. Plate 1, fig. 18.**

Valve lanceolate with truncate ends. Length, 0.017 to 0.03 mm; breadth, 0.005 to 0.0068. Axial areas very narrow. Central areas a broad stauros, widened and truncate outwards. Striæ slightly radiate, 20 to 24 in 0.01 mm, crossed by three to five broad, blank, longitudinal, undulating bands. Striæ finely punctate. Not common. Sample 1.

**NAVICULA PSEUDOSEMINULUM var. CURTA var. nov. Plate 1, fig. 19.**

A form with small valves. Length, 0.008 to 0.01 mm; breadth, 0.005. Striæ 24 in 0.01 mm. Sample 1.

**NAVICULA EXIGUA (Gregory) O. Muller var. CALCUTTENSIS var. nov. Plate 1, fig. 20.**

Valve lanceolate with capitate ends. Length, 0.018 mm; breadth, 0.005. Central areas a short fascia. Striæ radiate, 18 in 0.01 mm. Not common. Sample 1.

**NAVICULA CAPITELLATA sp. nov. Plate 1, fig. 21.**

Valve lanceolate, slightly gibbous in the middle with short capitate ends. Length, 0.016 mm; breadth, 0.0045. Median line straight, axial areas narrow, somewhat dilated in the middle. Striæ 15 to 18 in 0.01 mm, slightly radiate. This species resembles *Navicula bicapitellata* Hustedt. Not common. Sample 2.

**NAVICULA BUDDA sp. nov. Plate 1, fig. 22.**

Valve small, lanceolate with parallel margins, ends truncate. Length, 0.012 mm; breadth, 0.006. Median line filiform. Axial area very narrow, central area orbicular. Striæ 15 in 0.01 mm, radiate at the ends, more distant in the middle. Rare. Sample 2.

**NAVICULA BOSEANA sp. nov. Plate 1, fig. 23.**

Valve lanceolate with subrostrate rounded ends. Length, 0.01 to 0.015 mm; breadth, 0.0025 to 0.0034. Axial areas very narrow, median line straight. Striæ slightly radiate, in the middle bilaterally shortened. Central area widened and truncate outwards. This small species is connected with *Navicula minuta* Grun. Named in honor of S. R. Bose, professor of botany, Carmichael Medical College, Calcutta, India. Common. Samples 1 and 2.

**NAVICULA BOSEANA var. BACILLUM var. nov. Plate 1, fig. 24.**

Valve linear, obtuse. Length, 0.021 mm; breadth, 0.0034. Striæ 15 to 16 in 0.01 mm. Differs from the type by its linear obtuse valve.

**NAVICULA MEDICA sp. nov. Plate 1, fig. 25.**

Valve broad-lanceolate with parallel margins and cuneate ends. Length, 0.013 to 0.015 mm; breadth, 0.004. Median line straight, axial areas very narrow. Central areas a broad stauros, widened and truncate outwards. Striæ 18 to 20 in 0.01 mm, slightly radiate. *Navicula medica* is an isolated species, akin to *Navicula boseana.*

**NAVICULA CALCUTTENSIS sp. nov. Plate 1, fig. 26.**

Valve lanceolate, narrowed toward the ends. Length, 0.02 mm; breadth, 0.004. Axial area very narrow; central area small. Median lines straight with approximate central pores. Striæ 15 in 0.01 mm, slightly radiate towards the ends. This species is connected with *Navicula falaisiensis* Grun. Common. Sample 2.

**NAVICULA CALCUTTENSIS var. GRACILIS var. nov. Plate 1, fig. 27.**

Valve lanceolate with obtuse ends. Length, 0.015 mm; breadth, 0.0028. Striæ 18 in 0.01 mm. Var. *gracilis* differs from the type by its smaller size and obtuse ends. Common. Sample 2.

**PINNULARIA CALCUTTA sp. nov. Plate 1, fig. 28.**

Valve linear, narrowed towards the ends. Ends strongly capitate. Length, 0.026 mm; breadth, 0.0034. Axial area narrow, somewhat dilated in the middle. Central area a broad transverse fascia. Striæ radiate, divergent in the middle, convergent at the ends, 18 in 0.01 mm. This species has some resemblance to *Pinnularia divergentissima* (Grun.) Cleve. Common. Samples 1 and 2.

**PINNULARIA CALCUTTA var. CURTA var. nov. Plate 1, fig. 29.**

Valve shorter. Length, 0.018 mm; breadth, 0.00034. Striæ 18 in 0.01 mm. Common. Sample 1.

**AMPHORA NORMANI Rabh. Plate 1, fig. 30.**

*Amphora normani* Rabh., VAN HEURCK, Synopsis (1880–81) pl. 1, fig. 12.

Valve narrowed towards the ends, capitate. Central area with a distinct broad fascia. Length, 0.014 to 0.017 mm; breadth, 0.003 to 0.0034. Very common. Known in fresh water. Samples 1 and 2.

**AMPHORA NORMANI Rabh. var. GIBBOSA var. nov. Plate 1, fig. 31.**

Valve gibbous, on the dorsal side with a broad fascia reaching the margin. Length, 0.017 mm; breadth, 0.005. Not common. Sample 1.

**AMPHORA VENETA Kutz. var. MINOR Frenguelli. Plate 1, fig. 32.**

*Amphora veneta* Kutz. var. *minor* FRENGUELLI, Diatom. d. los Arroyos del Durazno y las Brusquitas (1925) 148, pl. 1, figs. 3 and 4.

Valve small, undulated on the dorsal and straight on the ventral side. Length, 0.009 mm; breadth, 0.0038. Reported from South America. Rare. Sample 2.

**AMPHORA VENETA Kutz. var. INDICA var. nov. Plate 1, fig. 33.**

Valve gibbous with truncate ends. Length, 0.012 mm; breadth, 0.0034. Striæ in the middle 15 in 0.01 mm; at the ends 20 in 0.01 mm. This variety is nearly related to var. *gibbosa* Frenguelli.[2] A fresh- and brackish-water diatom. Common. Sample 2.

**AMPHORA PERPUSILLA Grun. Plate 1, fig. 34.**

*Amphora perpusilla* Grun., F. HUSTEDT, Bacillar. (1930) 343, fig. 627.

Valve very small, slightly siliceous. Length, 0.006 mm; breadth, 0.002. A fresh-water diatom. Rare. Sample 1.

**AMPHORA COFFEAEFORMIS Agardh. Plate 1, figs. 35 and 36.**

*Amphora coffeaeformis* Agardh., A SCHMIDT, Atlas Diatom. pl. 26, fig. 56.

Frustule lanceolate, gibbous in the middle. Length, 0.027 to 0.04 mm; breadth, 0.011 to 0.012. Median line slightly arcuate. Axial area narrow, somewhat dilated in the middle. Striæ slightly radiate, 10 dorsal striæ in 0.01 mm; 12 ventral striæ in 0.01 mm. A brackish-water species. Rare. Samples 1 and 2.

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[2] Diatomeas Fosiles Prebelgranense de Miramar (1926) 27, pl. 1, fig. 1.

**GOMPHONEMA PARVULUM** (Kutz.) Grun. Plate 1, figs. 38 and 39.

*Gomphonema parvulum* (Kutz.) Grun., F. HUSTEDT, Bacillar. (1930) 372, fig. 713*a*.

Valve lanceolate, with obtuse apex and base. Length, 0.018 to 0.022 mm; breadth, 0.005 to 0.006. Striæ slightly radiate, 15 to 16 in 0.01 mm, more distant in the middle than elsewhere. A fresh-water diatom. Rare. Sample 1.

**GOMPHONITZSCHIA INDICA** sp. nov. Plate 1, figs. 40 and 41.

Valve clavate, slightly gibbous in the middle, narrowed towards the appex and base. Length, 0.0085 to 0.011 mm; breadth, 0.002 to 0.0025. Costæ 12 to 15 in 0.01 mm. This species resembles *Gomphonitzschia ungeri*, but differs in having shorter valves and in the form of the ends. Not common. Sample 1.

**RHOPALODIA GIBBERULA** (Ehr.) O. Mull. var. **VAN HEURCKII** O. Mull. Plate 1, fig. 42.

*Rhopalodia gibberula* (Ehr.) O. Mull. var. *Van Heurckii* O. Mull., F. HUSTEDT, Bacillar. (1930) 391, fig. 744.

Valve gibbous in the middle of the dorsal side, straight on the ventral side, with reflexed apices. Costæ 3 to 5 in 0.01 mm. Striæ 16 in 0.01 mm. Length, 0.022 to 0.033 mm. A brackish-water species. Sample 1, rare.

**HANTZSCHIA AMPHIOXYS** (Ehr.) Grun. var. **XEROPHILA** Grun. Plate 1, fig. 43.

*Hantzschia amphioxys* (Ehr.) Grun. var *xerophila* Grun., GRUNOW, Diatom. Franz Josefs Land 47.

Valve linear with truncate ends. Length, 0.03 to 0.035 mm; breadth, 0.005 to 0.006. Costæ 6 to 7 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. A fresh-water form. Common. Samples 1 and 2.

**NITZSCHIA THERMALIS** Kutz. Plate 1, figs. 44 and 45.

*Nitzschia thermalis* Kutz., F. HUSTEDT, Bacillar. (1930) 403, fig. 771.

Valve linear with truncate ends. Margins parallel. Length, 0.0034 to 0.073 mm; breadth, 0.0068 to 0.0076. Costæ 6 to 9 in 0.01 mm. Striæ 24 to 30 in 0.01 mm. A fresh-water diatom. Common. Sample 2.

**NITZSCHIA THERMALIS** Kutz. var. **CURTA** var. nov. Plate 1, fig. 46.

Valve short, linear, narrowed towards the ends. Margin parallel. Length, 0.019 mm; breadth, 0.009. Costæ 13 to 15 in 0.01 mm. Striæ 35 in 0.01 mm. Common. Sample 2.

**NITZSCHIA COMMUTATA Grun. Plate 1, fig. 47.**

*Nitzschia commutata* Grun., F. HUSTEDT, Bacillar. (1930) 405, fig. 774.

Valve linear, slightly constricted in the middle with truncate, rounded ends. Length, 0.06 mm; breadth, 0.0068. Costæ 7 in 0.01 mm. A species of slightly brackish water. Not common. Sample 2.

**NITZSCHIA COMMUTATA Grun. var. CURTA var. nov. Plate 1, fig. 48.**

Valve constricted with rostrate ends. Length, 0.02 mm; breadth, 0.005. Costæ 12 in 0.01 mm. Striæ 24 in 0.01 mm. This variety differs from the type in having shorter valves. Not common. Sample 2.

**NITZSCHIA PALEA (Kutz.) W. Smith. Plate 1, fig. 49.**

*Nitzschia palea* (Kutz.) W. Smith, A. SCHMIDT, Atlas Diatom. pl. 349, figs. 1 to 8.

Valve linear with rostrate ends. Length, 0.017 to 0.034 mm; breadth, 0.0025 to 0.0034. Keel puncta 10 to 15 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. A fresh-water species. Common. Samples 1 and 2.

**NITZSCHIA PALEA (Kutz.) W. Smith var. TENUIROSTRIS Grun. Plate 1, fig. 50.**

*Nitzschia palea* (Kutz.) W. Smith var. *tenuirostris* Grun., VAN HEURCK, Synopsis (1880–81) pl. 69, fig. 31.

Valve linear-lanceolate with attenuated ends. Length, 0.034 to 0.037 mm; breadth, 0.003 to 0.0038. Keel puncta 9 to 11 in 0.01 mm. Striæ 35 in 0.01 mm. Common. Samples 1 and 2.

**NITZSCHIA VERMICA sp. nov. Plate 1, figs. 51 to 53.**

Valve linear, vermiform or slightly sigmoid. Ends unilaterally rounded. Length, 0.012 to 0.018 mm; breadth, 0.002 to 0.0028. Keel puncta 12 in 15 mm. Striæ 24 in 0.01 mm. A species related to *Nitzschia frustulum* (Kutz.) Grun. Common. Samples 1 and 2.

**NITZSCHIA FONTICOLA Grun. Plate 1, figs. 54 and 55.**

*Nitzschia fonticola* Grun., A. SCHMIDT, Atlas Diatom. pl. 348, figs. 63–65.

Valve broad-lanceolate with attenuated subacuminate ends. Length, 0.018 to 0.02 mm; breadth, 0.0035 to 0.0042. Costæ strong, 12 in 0.01 mm. Striæ 30 in 0.01 mm. A fresh-water species. Common. Sample 2.

**NITZSCHIA FONTICOLA Grun var. CONSTRICTA var. nov. Plate 1, fig. 56.**

Valve lanceolate, constricted on one side, slightly gibbous on the other. Length, 0.01 mm; breadth, 0.002. Keel puncta 12 in 0.02 mm. Striæ 24 in 0.01 mm. Common. Sample 2.

**NITZSCHIA COMMUNIS Rabh. Plate 1, fig. 60.**

*Nitzschia communis* Rabh., FR. HUSTEDT, Bacillar. (1930) 417, fig. 793.

Valve lanceolate with narrowed ends. Length, 0.018 to 0.035 mm; breadth, 0.003 to 0.0042. Keel puncta 9 to 15 in 0.01 mm. Striæ 35 in 0.01 mm. A blackish-water diatom. Common. Samples 1 and 2.

**NITZSCHIA AMPHIBIA Grun. Plate 1, fig. 57.**

*Nitzschia amphibia* Grun., F. HUSTEDT, Bacillar. (1930) 414, fig. 793.

Valve lanceolate with keel puncta extended into short costæ. Costæ 3.4 to 4.2 in 0.01 mm. Puncta coarse, 15 in 0.01 mm. Length, 0.02 to 0.2 mm; breadth, 0.0034 to 0.0042. A fresh-water diatom. Not common. Sample 2.

**NITZSCHIA AMPHIBIA Grun. var. ACUTIUSCULA Grun. Plate 1, fig. 58.**

*Nitzschia amphibia* Grun. var. *acutiuscula* Grun., A. SCHMIDT, Atlas Diatom. pl. 348, figs. 42–44.

Differs from the type by more-lanceolate valves. Length, 0.02 mm; breadth, 0.0042. Costæ 6 to 7 in 0.01 mm. Striæ 14 in 0.01 mm. Not common. Sample 2.

**NITZSCHIA FRUSTULUM (Kutz.) Grun. var. PERMINUTA Grun. Plate 1, fig. 59.**

*Nitzschia frustulum* (Kutz.) Grun. var. *perminuta* Grun., VAN HEURCK, Synopsis (1880–81) pl. 99, fig. 7.

Valve linear-lanceolate with obtuse ends. Length, 0.011 to 0.017 mm; breadth, 0.002 to 0.0025. Keel puncta 12 to 15 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. A brackish-water diatom. Common. Samples 1 and 2.

**NITZSCHIA FRUSTULUM (Kutz.) Grun. var. PERPUSILLA (Rabh.) Grun. Plate 1, figs. 37 and 61.**

*Nitzschia frustulum* (Kutz.) Grun. var. *perpusilla* (Rabh.) Grun., VAN HEURCK, Synopsis (1880–81) pl. 98, figs. 25 and 26; pl. 99, fig. 6.

Valve lanceolate. Length, 0.0085 to 0.012 mm; breadth, 0.002 to 0.0025. Keel puncta 12 to 15 in 0.01 mm. Striæ 24 in 0.01 mm. Common. Samples 1 and 2.

**NITZSCHIA FRUSTULUM (Kutz.) Grun. var. INDICA var. nov. Plate 1, fig. 62 and 63.**

Valve very short. Length, 0.005 to 0.0085 mm; breadth, 0.002 to 0.0025. Keel puncta 18 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. Common. Samples 1 and 2.

**NITZSCHIA MICROCEPHALA Grun. Plate 1, fig. 64.**

*Nitzschia microcephala* Grun., F. HUSTEDT, Bacillar. (1930) 414, fig. 791.

Small valve with rostrate ends. Length, 0.011 to 0.012 mm; breadth, 0.0025 to 0.0037. Keel puncta 11 to 15 in 0.01 mm. Striæ 35 in 0.01 mm. A fresh-water species. Common. Samples 1 and 2.

**NITZSCHIA FILIFORMIS (W. Smith) Hustedt. Plate 1, fig. 65.**

*Nitzschia filiformis* (W. Smith) Hustedt, F. HUSTEDT, Bacillar. (1930) 422, fig. 818.

Valve linear, curved. Length, 0.042 mm; breadth, 0.0034. Costæ 10 to 12 in 0.01 mm. Striæ 35 in 0.01 mm. A brackish-water diatom. Rare. Sample 2.

**NITZSCHIA OBTUSA W. Smith var. SCALPELLIFORMIS Grun. Plate 1, figs. 66 and 67.**

*Nitzschia obtusa* W. Smith var. *scalpelliformis* Grun., VAN HEURCK, Synopsis (1880–81) pl. 67, fig. 2.

Valve slightly sigmoid. Margins parallel. Length, 0.064 to 0.093 mm; breadth, 0.007 to 0.0085. Costæ 8 to 9 in 0.01 mm. Striæ 30 to 35 in 0.01 mm. A brackish-water diatom. Common. Sample 2.

# ILLUSTRATION

## PLATE 1

FIG. 1. *Melosira Roeseana* Rabh. var. *indica*. var. nov.
2. *Achnanthes exigua* Grun.
3. *Achnanthes exigua* Grun. var. *indica* var. nov.
4. *Diploneis puella* (Schumann) Cleve.
FIGS. 5 and 6. *Stauroneis calcuttensis* sp. nov.
FIG. 7. *Stauroneis parvula* Grun. var. *lanceolata* var. nov.
8 *Navicula cuspidata* Kutz. var. *ambigua* (Ehr.) Cleve.
9. *Navicula viridula* Kutz. var. *calcuttensis* var. nov.
10. *Navicula menisculus* Schumann.
11. *Navicula cryptocephala* Kutz.
12. *Navicula cryptocephala* Kutz. var. *veneta* Kutz.
13. *Navicula microcephala* Grun.
14. *Navicula pygmaea* Kutz. var. *indica* var. nov.
15. *Navicula insociabilis* Krasske.
16. *Navicula insociabilis* Krasske var. *lanceolata* var. nov.
17. *Navicula seminulum* Grun.
18. *Navicula pseudoseminulum* sp. nov.
19. *Navicula pseudoseminulum* var. *curta* var. nov.
20. *Navicula exigua* (Gregory) O. Mull. var. *calcuttensis* var. nov.
21. *Navicula capitellata* sp. nov.
22. *Navicula budda* sp. nov.
23. *Navicula Boseana* sp. nov.
24. *Navicula Boseana* var. *bacillum* var. nov.
25. *Navicula medica* sp. nov.
26. *Navicula calcuttensis* sp. nov.
27. *Navicula calcuttensis* var. *gracilis* var. nov.
28. *Pinnularia calcutta* sp. nov.
29. *Pinnularia calcutta* var. *curta* var. nov.
30. *Amphora Normani* Rabh.
31. *Amphora Normani* var. *gibbosa* var. nov.
32. *Amphora veneta* Kutz. var. *minor* Frenguelli.
33. *Amphora veneta* (Kutz.) var. *indica* var. nov.
34. *Amphora perpusilla* Grun.
FIGS. 35 and 36. *Amphora coffeaeformis* Agardh.
FIG. 37. *Nitzschia frustulum* (Kutz.) Grun. var. *perminuta* Grun.
FIGS. 38 and 39. *Gomphonema parvulum* (Kutz.) Grun.
40 and 41. *Gomphonitzschia indica* sp. nov.
FIG. 42. *Rhopalodia gibberula* (Ehr.) O. Mull. var. *Van Heurckii* O. Mull.
43. *Hantzschia amphioxys* (Ehr.) Grun. var. *xerophila* Grun.
FIGS. 44 and 45. *Nitzschia thermalis* Kutz.

FIG. 46. *Nitzschia thermalis* Kutz. var. *curta* var. nov.
47. *Nitzschia commutata* Grun.
48. *Nitzschia commutata* Grun. var. *curta* var. nov.
49. *Nitzschia palea* (Kutz.) W. Smith.
50. *Nitzschia palea* (Kutz.) W. Smith var. *tenuirostris* Grun.
FIGS. 51 to 53. *Nitzschia vermica* sp. nov.
54 and 55. *Nitzschia fonticola* Grun.
FIG. 56. *Nitzschia fonticola* Grun. var. *constricta* var. nov.
57. *Nitzschia amphibia* Grun.
58. *Nitzschia amphibia* Grun. var. *acutiuscula* Grun.
59. *Nitzschia frustulum* (Kutz.) Grun. var. *perminuta* Grun.
60. *Nitzschia communis* Rabh.
61. *Nitzschia frustulum* (Kutz.) Grun. var. *perpusilla* (Rabh.) Grun.
FIGS. 62 and 63. *Nitzschia frustulum* (Kutz.) Grun. var. *indica* var. nov.
FIG. 64. *Nitzschia microcephala* Grun.
65. *Nitzschia filiformis* (W. Smith) Hustedt.
FIGS. 66 and 67. *Nitzschia obtusa* W. Smith var. *scalpelliformis* Grun.

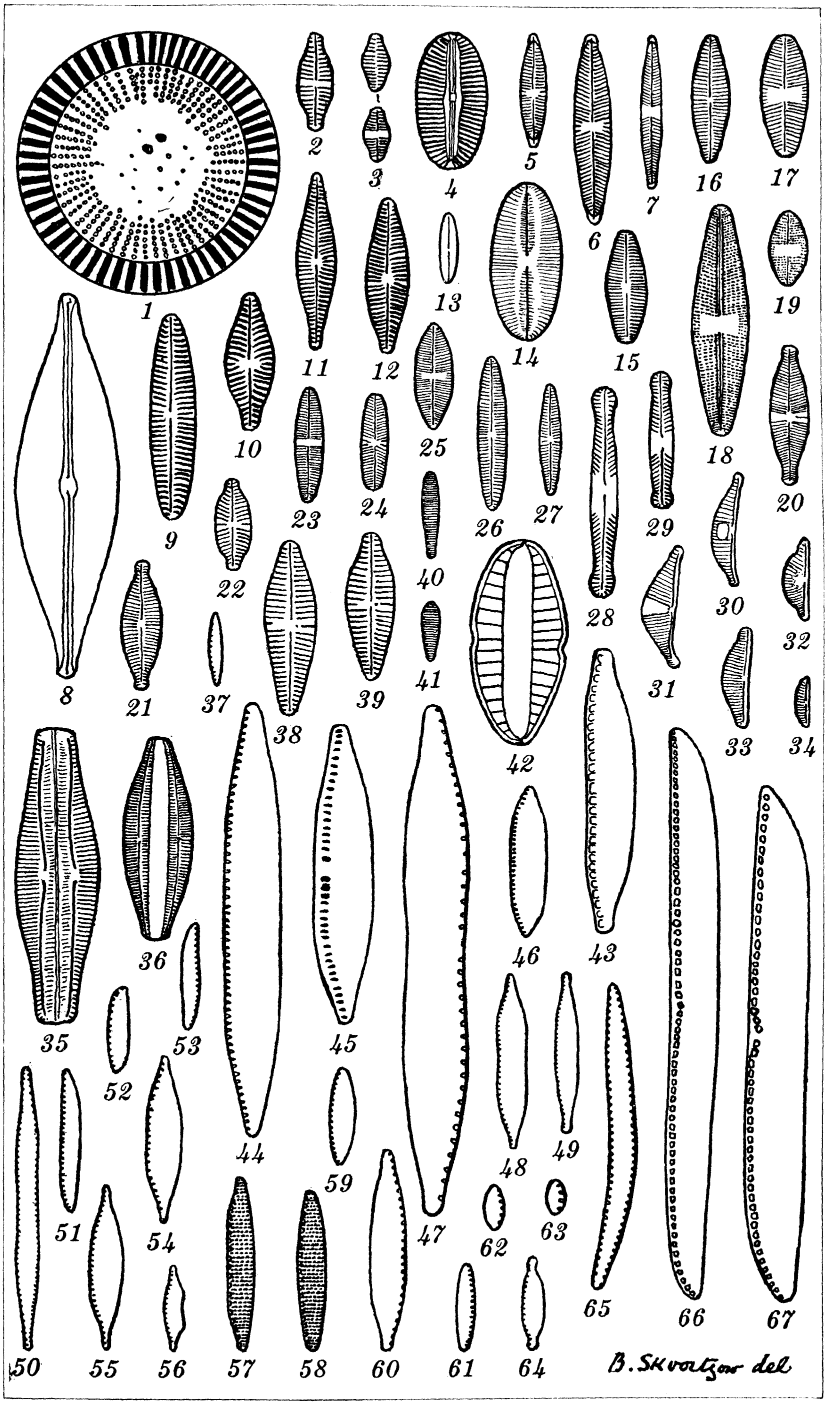

PLATE 1.

UNIV. OF MICH.

# LIFE HISTORY AND ECONOMIC IMPORTANCE OF CABANIS'S WEAVER

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ONE PLATE

## INTRODUCTION

Cabanis's weaver, *Munia cabanisi* Sharpe (Plate 1), is one of the Philippine weavers condemned by rice growers for the alleged damage they do to crops. The local names of this weaver, *bilit toleng* (Ilk.), *denas paking* (Pamp.), *mayang paking* (Tag.), all imply that the bird is deaf, obviously owing to the difficulty of driving it away from rice fields when the grain is in head. The species belongs to the subfamily Estrildinæ (= Viduinæ) of the family Ploceidæ. The description of the bird is given by Sharpe (1890), McGregor (1908), and others. The adult bird is relatively small, brownish raw umber above with light-colored shafts. The chin is Prout's brown, each feather being provided with lighter shaft lines. The upper tail coverts and rectrices are yellowish olive. The breast, abdomen, and other underparts are white, each feather with an exposed broad brown band surrounding the white median streak. The brown band is partly surrounded by a somewhat U-shaped white band, with a portion of its free arms covered by the overlapping feathers. The white band is continuous into a whitish buff fringe.

The sexes are similar. Measurements of twenty adult birds from various provinces in Luzon give the following averages: Length, 102 millimeters; wing, 50; culmen, 10.4; tail, 42; tarsus, 13.

## DISTRIBUTION

Like its congener *Munia jagori, M. cabanisi* is an endemic species, but with a more-limited distribution. Sharpe (1890) says that it is confined to Luzon. Whitehead (1899) found the species to be very local. He met these birds feeding on grass seeds in Abra. McGregor (1909) cites Bourns and Worcester as having seen Cabanis's weaver in Panay once. The collection of birds in the Bureau of Science, Manila, with samples from many parts of the Archipelago, shows that, except for a young female from Mindoro, *M. cabanisi* is found only in Luzon. It is abundant in northern and central Luzon, but appears to be rare in the southern part. Attempts to obtain specimens in Camarines Sur and Sorsogon Provinces in April, 1934, failed.

## METHOD OF STUDY

Information about the general habits of the species was obtained through field observation, while the data on its food were secured by the examination of stomach contents.

The food of the young was determined qualitatively and only very superficially through the semitransparent skin of the throat.

The contents of the alimentary tract, including those of the stomach, of adult birds, were considered in the estimate. Collection of material was started in June, 1932, and observations on the behavior of the species were made as early as 1926. The latest records were made in April, 1934, and observations were still being made during the writing of this paper (March, 1935).

The birds used in this study were obtained from over one hundred collecting grounds in thirty-eight municipalities of ten provinces. Observations covered a larger area.

In the present study the percentage by bulk, based on the actual number of seeds recovered in the stomachs of the bird, was used. The percentage composition of the food was obtained by dividing the number of seeds of one weed item by the total number of weed seeds recovered and multiplied by 100. Likewise, the percentage of the seeds of weeds and of rice were obtained by dividing the number of seeds of weeds and of rice, respectively, by the total number of seeds obtained and multiplied by 100.

Weed seeds were determined by comparison with identified seeds.

As the weed seeds that enter into the food composition of Cabanis's weaver are numerous and as the seeds are oftentimes recovered in a more or less fragmentary condition, no high degree of precision is claimed in their specific determination. Care was taken, however, in segregating the rice from the weed seeds.

## NIDIFICATION

The species is monogamous. Each pair was seen feeding together in the fields. They were also seen alternately feeding their young and bringing building materials to the nest.

Mating occurs on the perch. The act is generally preceded by an unusual activity of one bird, presumably the male. This activity consists of poking the other bird, moving over it to the other side, and side-stepping.

In the course of study information was gathered with regard to the breeding period of Cabanis's weaver. Even persons residing close to each other reported different breeding seasons for this species. Some claimed that the species nests throughout the year, others believed that the same nest is used by one pair after another; still others maintained that nesting is confined only to a few months of the year. The latter also differed with respect to the period in which the birds build their nests. Personal observation in a number of places in Rizal and Laguna Provinces indicates that the breeding season of *M. cabanisi* extends throughout the year, reaching its peak between the latter part of May and early August. There is a nesting rest period sometime between October and February. A pair raises more than one brood a year and may use the same nest again. The building of a new nest near an old one by the same pair was also noted. The change may be due to unfavorable elements in the old site.

The nests are built from about 3 meters to about 10 meters above the ground. They are usually seen in thin brush near open fields and in inhabited districts. Nests were noted in places as high as 80 meters above sea level. The record of this species in Benguet, giving an elevation of about 1,500 meters, suggests the possibility of it nesting in higher altitudes.

The gregariousness of this species is manifested even by nest building. Isolated nests, however, are not uncommon. In such cases the nest is always well concealed by the plant. This condition was observed in the nest found in an areca nut palm (*Areca catechu* Linn.), a royal palm (*Oreodoxa regia* HBK), a banana, a mango (*Mangifera indica* Linn.), a pili [*Canarium luzonicum* (Blume) A. Gray], a kallos (*Streblus asper* Lour.), a tamarind (*Tamarindus indica* Linn.), and a kamachili [*Pithecolobium dulce* (Roxb.) Benth.]. In July, 1926, thirty-four nests were counted in five citrus trees close to each other on the campus of the College of Agriculture, University of the Philippines. In the same place, July 12, 1933, Francisco Rivera noted ten nests in a balubo tree (*Diplodiscus paniculatus* Turcz.).

## THE NEST

The nest (Plate 2) is about 20 centimeters long, with the opening at one end, somewhat retort-shaped with its long axis horizontal. The distance between the outer surface of the bottom and that of the top is about 15 centimeters. Generally it is laterally compressed, the effect of the supporting branches probably being taken into account. The distance between the two sides is about 12 centimeters.

Bamboo leaves, ragged pieces of banana fiber, chicken feathers, and stalks, leaves, and inflorescences of weeds are used in nest construction. During the peak of the breeding season leaves and flowers of cogon (*Imperata cylindrica* Linn.) are abundant and are used largely as nesting materials.

The nest has an inner and an outer layer. The inner layer is more compact and made up of fine materials. The inside lining is made of finely woven pedicels of weeds. Oftentimes, especially during June, July, and August, flowers of cogon are laid inside the nest. These provide a comfortable, soft, warm lining for the young reared during the cooler months. The inner layer, when separated from the outer covering, has the shape of a gastrula whose blastophore is represented by the opening of the nest. This opening has a diameter of about 4 centimeters. The cavity has a diameter of about 7 centimeters. The inner layer is very distinct from the outer which defines the shape of the nest and which strengthens the nest through its materials that hold the nest against the supporting branches. The materials of the outer layer are loosely woven, making the nest oftentimes appear as a mere bulk of dried leaves. The fringing materials of the outer layer over the opening conceal this part from above and reduce its actual size. The opening is always away from the supporting branches and directed downwards.

The male and the female work together in building the nest. They alternately carry blades of grass from the ground to the nest site, although frequently one of them does the work alone, the other staying near the nest most of the time. The source of materials varies from about 5 meters to about 60 or even 80 meters away, depending upon the height and location of the nest. Generally, however, nesting materials are obtained from the neighborhood of the nest site, within a radius of from 10 to 20 meters. Observation shows that a nest could be built in an average of seven days.

The nest is constructed from outside inward, beginning with the fastening of the supporting branches. Materials are then added one by one until the soft lining is completed.

## EGGS

Normally the clutch consists of five or six eggs. Rarely do four, seven, or eight eggs constitute the full complement of a set. The eggs are indistinguishable from those of *M. jagori*, described in a former paper (Manuel, 1930). The average measurement of fifty-four eggs is 16 by 11.3 millimeters.

## YOUNG

Three or four young are generally hatched. These appear externally similar to those of *M. jagori* Manuel (1930), until their seventh day when they begin to differ in color and size. The young of Cabanis's weaver very gradually becomes Prout's brown above and matt snuff brown on the under surface. The tail gradually attains its yellowish olive tint. At seven days the young Cabanis's weaver is smaller than a Philippine weaver (*M. jagori*) of the same age.

## FOOD AND FEEDING HABITS

Like that of other weavers, the food of Cabanis's weaver consists of seeds. However, the kind and amount of seeds taken differ in the various parts of its range and in different seasons of the year, with a consequent difference in economic effects.

## FOOD OF THE YOUNG

The young feeds entirely on weed seeds. In this respect the weaver, together with the dove and pigeon (Judd, 1900), constitutes an exception to the general observation that nestling birds at first subsist on an animal diet. The kind and number of seeds depend largely upon the location of the nest and the activity of the parents. Observation on forty-seven young shows an average of about seventy seeds in a crop. As many as two hundred seeds were noted in one stomach. Data on the total number of seeds eaten by each nestling in one day are not available. Bailey (1905) hinted that birds with crop and stomach refill these twice a day. This is not applicable to young weaver nestlings, as they receive a supply of food from the adults at intervals many times during the day. The observations of Judd (1900), indicating the number of times nestling birds were visited in one day, even granting the estimate to be true with Cabanis's weavers, are of no value in determining the daily consumption of weed seeds by each young, since the number of seeds offered at one time was not noted. Unfor-

TABLE 1.—*Food of Cabanis's weavers studied.*

| Date. | | Province. | Town. | Collecting ground. | Birds obtained. | Composition of food. | | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Cultivated (rice). | Uncultivated (mostly weed seeds). | |
| | | | | | | *Per cent.* | *Per cent.* | |
| June | 1932 | Rizal | Novaliches | Vacant rice field; weeds in abundance. | 32 | 0.1 | 99.9 | Rice seed bed noted near one of the collecting grounds. |
| June | 1933 | do | Binangonan, Tanay, and Pililla. | All along shore of Laguna de Bay; rice in head | 55 | 33.3 | 66.7 | Injurious. |
| July | 1932 | do | Novaliches | Rolling open country | 64 | 0.5 | 99.5 | |
| July | 1932 | Bulacan | San José del Monte | do | 4 | | | |
| July | 1933 | Rizal | Alabang | Vacant rice field | 6 | 0.01 | 99.99 | Seeds of bukáui, a species of wild bamboo, were secured in one stomach. |
| July | 1933 | do | Novaliches | do | 19 | | | |
| July | 1933 | Laguna | Los Baños | do | 24 | | | |
| July | 1933 | do | Bay | do | 7 | | | |
| Aug. | 1932 | do | Biñan | do | 15 | 5.4 | 94.6 | Riceseedlings and rice in head in vicinity of collecting ground in Biñan.<br>In Pila birds were suspected of feeding on rice in seed beds. |
| Aug. | 1932 | do | Los Baños | do | 4 | | | |
| Aug. | 1932 | do | Pila | do | 14 | | | |
| Aug. | 1932 | Tayabas | Mauban | | 6 | | | |
| | | Batangas | Balayan | Rice in head | 2 | | | |
| Aug. | 1932 | do | Lipa | Near upland rice in head | 1 | | | |
| Aug. | 1932 | do | Tanauan | Rice in head and gabi plantation on a plateau. | 6 | | | |
| Aug. | 1933 | Rizal | Novaliches | Vacant rice field weeds in abundance. | 7 | 0.00 | 100.00 | |
| Sept. | 1932 | Laguna | Los Baños | Rice in head noted in vicinity | 18 | 2.22 | 97.78 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Oct. | 1932 | Bulacan | Makinabang | Near rice in bloom | 48 | 1.18 | 98.82 | Percentage of food composition from each collecting ground depends directly on the availability of the food plant. |
| Oct. | 1932 | do | Pulilan | Vacant rice field; about 2 km from rice in head. | 32 | | | |
| Oct. | 1932 | do | Quingua | Vacant rice field | 16 | | | |
| Oct. | 1932 | do | San Ildefonso | do | 4 | | | |
| Oct. | 1932 | do | San Rafael | Rice in field; grain in head | 19 | | | |
| | | do | Baliuag | Near rice in head | 1 | | | |
| | | do | Bustos | Vacant rice field; about 4 km from rice in head. | 24 | | | |
| Oct. | 1932 | Pampanga | Apalit | Rice in head | 16 | | | |
| | | do | Angeles | Near rice in head. | 5 | | | |
| | | do | San Fernando | Vacant rice field near rice in head | 7 | | | |
| Oct. | 1932 | Nueva Ecija | Cabanatuan | Near rice in head and in fields away from this. | 18 | | | |
| | | do | Talavera | Rice not in head | 7 | | | |
| | | do | Santa Rosa | Vacant rice field; about 3 km from rice in head. | 6 | | | |
| | | do | Gapan | Rice in head | 15 | | | |
| Oct. | 1932 | Tarlac | Bamban | Near rice in head | 6 | | | |
| | | do | Capas | do | 5 | | | |
| | | do | Murcia | Rice in head | 2 | | | |
| Nov. | 1932 | Rizal | Maketipo | Rice ready for harvest | 12 | 20.23 | 79.77 | Injurious. |
| | | do | Novaliches | do | 15 | | | |
| | | do | San Pedro Makati | do | 29 | | | |
| Dec. | 1932 | do | Novaliches | Near rice in harvest | 12 | 12.93 | 87.07 | |
| | | do | Alabang | do | 15 | | | |
| Dec. | 1932 | Pangasinan | Infanta | Newly harvested rice field | 1 | | | |
| Dec. | 1932 | Zambales | Subic | do | 4 | | | |
| Jan. | 1933 | Rizal | San Pedro Makati | do | 5 | 17.42 | 82.58 | Birds were shot on rice stacks. |
| Jan. | 1934 | Laguna | San Pedro Tunasan | do | 1 | 15.84 | 84.16 | |
| Feb. | 1933 | Rizal | San Pedro Makati | Vacant rice field | 4 | 12.41 | 87.59 | Birds were shot on rice stacks in Makati. |
| Feb. | 1933 | Bulacan | Baliuag | Newly harvested rice fields | 12 | | | |
| Feb. | 1933 | do | Pulilan | do | 12 | | | |
| Feb. | 1933 | Pampanga | Apalit | do | 31 | | | |
| | | do | San Luis | do | 6 | | | |

TABLE 1.—*Food of Cabanis's weavers studied*—Continued.

| Date. | | Province. | Town. | Collecting ground. | Birds obtained. | Composition of food. | | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Cultivated (rice). | Uncultivated (mostly weed seeds). | |
| | | | | | | *Per cent.* | *Per cent.* | |
| Mar. | 1933 | Bulacan | Baliuag | Rice in head | 4 | 75.00 | 25.00 | Injurious, but samples were inadequate. |
| Mar. | 1934 | Laguna | Pansol | Vacant rice fields. | 8 | 28.08 | 71.92 | Injurious. |
| | | do | Calamba | By a field; rice in head | 18 | | | |
| | | do | Cabuyao | Vacant rice field; about 3 km from rice field. | 6 | | | |
| | | do | Biñan. | Rice in head | 13 | | | |
| | | do | San Pedro Tunasan | do | 23 | | | |
| | | Rizal | Muntinlupa | Vacant rice field. | 14 | | | |
| Apr. | 1933 | do | Alabang | do | 1 | 100.00 | ---------- | Injurious, but sample was inadequate. |
| Apr. | 1934 | Laguna | Cabuyao | Newly harvested rice field | 14 | 1.76 | 98.24 | |
| Apr. | 1934 | Rizal | Alabang | Vacant rice field. | 8 | | | |
| May | 1933 | do | Novaliches | do | 1 | 19.06 | 80.94 | |
| May | 1933 | Laguna | Los Baños | do | 4 | | | |
| May | 1933 | Bulacan | Baliuag | Rice in head | 8 | | | |
| May | 1933 | Pampanga | Apalit. | do | 4 | | | |

tunately, the number of seeds given at one time cannot be accurately determined.

The male and the female Cabanis's weavers take turns in feeding the young. The food is given by the parents in pellets and the seeds are obviously devoid of coats when offered.

### FOOD OF ADULTS

Determination of the food of adult birds was largely based on the results of stomach examination. Collection was begun from vacant rice fields in Novaliches, Rizal Province, in June, 1932, when thirty-two birds were secured in three days. Weeds were in head and the birds were seen feeding on them. The presence of a rice seed bed near one of the collecting grounds probably accounts for the presence of rice seeds in two stomachs in combination with weed seeds. Rice seeds comprised 0.1 per cent of the total food. Two stomachs were empty. The other stomachs all contained weed seeds, with sabung-sabuñgan (*Panicum flavidum* Retz.) in the majority of them. This weed comprised 95.8 per cent of the weed food of the birds examined for this month.

Examination of the stomach contents of birds obtained in June, 1933, from the towns of Binangonan, Tanay, and Pililla, along the shore of Laguna de Bay in Rizal Province, yielded different results. Collecting was done in places near rice in head. With the exception of one empty stomach the stomachs of the fifty-five birds collected contained 33.3 per cent rice, the balance consisting of weed seeds. Of the weed seeds those of daua-dauahan (*Panicum crus-galli* Linn.) formed 78.8 per cent; sabung-sabuñgan, 20 per cent; tiribuhan (*Panicum colonum* Linn.) and amor seco (*Andropogon aciculatus* Retz.), a little over 1 per cent.

Material for July, 1932, was obtained from Novaliches, Rizal Province, and from San Jose del Monte, Bulacan Province. These two places are situated near each other in rolling, open country with uniform ecological conditions. The region, at the time, was largely cogonal with an occasional patch of upland rice. Sixty-eight Cabanis's weavers were collected during the month. The stomachs of seven birds were empty. The stomach contents of sixty-one birds yielded 0.5 per cent rice, seeds of seven species of weeds, and bokáui [*Schizostachyum lumampao* (Blco.) Merr.], a species of wild bamboo, representing 99.5 per cent. Of the uncultivated species, seeds of sabung-sabuñgan and paragis (*Paspalum scrobiculatum* Linn.) made up the greater part, being 51.8 per cent and 26.6 per cent, respectively. Other weeds recovered were amor seco, tiribuhan, daua-dauahan, and laau-laau (*Paspalum conjugatum* Berg.). Bokáui constituted 3.4 per cent of the uncultivated plants.

Data for July, 1933, were secured from stomachs of birds collected from Alabang and Novaliches, Rizal Province, and from Los Baños and Bay, Laguna Province.

Six birds collected in a vacant rice field in Alabang all had daua-dauahan in their stomachs.

From Novaliches nineteen birds were studied. Collecting was done in a vacant rice field where weeds were in abundance, which probably accounts for all the stomachs but one having weed seeds. Rice was noted mixed with weed seeds in one stomach. The same condition obtained in thirty-one stomachs from Los Baños and Bay.

An estimate based on the data obtained for this month gave the food as being about 0.01 per cent rice and 99.99 per cent weed seeds.

Seven places in three provinces were visited for observation and collection of materials in August, 1932. From Laguna Province, collecting was done in Biñan, Los Baños, and Pila. In Biñan fourteen birds were collected within two days. Rice seedlings were being transplanted around the collecting place at the time, but rice in head was noted about 2 kilometers away. Four stomachs were empty. Two stomachs contained rice seeds, the rest weed seeds. All four birds collected in a vacant rice field in Los Baños had eaten weed seeds. The birds secured in lowland rice fields in Pila perhaps fed on nongerminating rice seeds, since birds shot in paddies where rice seedlings were being transplanted had this grain in seven of fourteen stomachs. The birds were noted on the fence inclosing the seed bed. Alleged feeding in seed beds causes this bird to be regarded with disfavor. This assumption, however, awaits confirmation. Two stomachs were empty. Weed seeds, some mixed with rice, were found in twelve stomachs. The contents of the stomachs of six Cabanis's weavers shot in Mauban, Tayabas Province, were weeds. One stomach was empty.

In Batangas Province, Cabanis's weavers were collected in the municipalities of Balayan, Lipa, and Tanauan.

Weeds were recovered from the stomachs of two birds obtained near rice in head in Balayan. In Lipa a bird shot near a rice field in head had rice in its stomach. Of six Cabanis's weavers obtained on a plateau in Tanauan two had empty stomachs and four had eaten rice. In two of the four stomachs weed seeds were recovered in addition. The field visited by Cabanis's weaver and *Munia jagori* was planted to upland rice in head. In the neighborhood was a gabi [*Colocasia esculentum* (Linn.) Schott] plantation in which weeds were growing abundantly. The birds moved back and forth between the gabi and rice fields.

The food of Cabanis's weaver for this month as shown by the materials studied consisted of 5.4 per cent rice and 94.6 per cent weed seeds. Tiribuhan, sabung-sabuñgan, and amor seco were the major weed items, while daua-dauahan, paragis, and luya-luyahan (*Panicum repens* Linn.) were represented to a lesser extent.

Observation and collection of Cabanis's weaver for August, 1933, were confined to Novaliches, Rizal Province. The stomachs of seven birds obtained in open fields where weeds were in abundance contained weed seeds. Tiribuhan and amor seco were the weeds noted.

All material for September, 1932, was obtained in Los Baños, Laguna. A number of paddies with rice ready for harvest were in the vicinity of the collecting grounds. Eighteen stomachs were dissected, five of which were emtpy. Rice seeds mixed with weed seeds were obtained from four stomachs. Seeds of seven species of weeds were identified from the contents of thirteen stomachs. It was estimated that rice made up 2.22 per cent of the stomach contents and weed seeds 97.78 per cent.

The largest number of stomachs of Cabanis's weaver examined for any one month was that for October, 1932. The materials were from seventeen places in four provinces. Various types of conditions prevailed in the different collecting places. In all two hundred thirty-one stomachs of Cabanis's weavers collected during the month were studied.

In Bulacan Province material was obtained from Makinabang, Baliuag, Pulilan, Quingua, San Ildefonso, San Rafael, and Bustos. From Makinabang forty-eight birds were collected. Rice was noted mixed with weeds in the stomachs of three of these. The others had eaten weeds in different combinations and various quantities. The birds were shot near rice fields when the plants were about to bloom. In Pulilan the birds were obtained in vacant fields about 2 kilometers away from rice in head. Rice was recorded in one stomach among thirty-two that have been examined from this place. Weed seeds were the contents of the other stomachs. From Quingua sixteen stomachs were examined; all contained weed seeds. Four birds were obtained from San Ildefonso. One stomach was empty, while weeds were recorded from three. Collecting in a field when rice was in head in San Rafael must have been the cause of the presence of rice in twelve stomachs out of nineteen. The grain was mixed with weed seeds in eight of that number, thus weed seeds were recorded in fifteen stomachs. The stomach of a lone bird from Baliuag contained rice and tiribuhan. Field work in Bustos resulted in the collection of twenty-four Cabanis's weavers. Collecting was done in a vacant rice field about 4 kilometers from fields where the grain was in head. The stomachs of five birds were empty. Rice was noted in five stomachs. Weed seeds were recovered from fifteen birds.

Twenty-eight stomachs were examined from the municipalities of Apalit, Angeles, and San Fernando in Pampanga Province. Eleven of the sixteen stomachs of Cabanis's weaver studied from Apalit contained rice. The presence of this grain in so many stomachs is attributable to the fact that collecting was done on the edge of a rice paddy, when the grain was in head. In seven of the stomachs rice was noted mixed with weeds, thus weeds were recovered in twelve stomachs. Five weavers were secured in a rice field in Angeles, four of which had rice in their stomachs. Weed seeds were also recorded in three of them. One was empty. In five of seven stomachs collected in San Fernando rice was recorded. Weed seeds were noted in four of these in combination with rice. Altogether, weeds were recorded in six stomachs.

In Nueva Ecija samples were obtained from the municipalities of Cabanatuan, Talavera, Santa Rosa, and Gapan. From a place in Cabanatuan near a rice field in head, ten stomachs were examined. Nine contained rice. Two species of weeds were noted in one stomach. In another place in the same municipality, collecting was done away from rice fields. The contents of all eight stomachs examined were weeds. Seven birds were secured near a rice field not in head in Talavera. Except in one stomach where rice was recorded in combination with weed seeds, all contained the latter item. Rice was recovered from two, while in five of the six stomachs studied from Santa Rosa weeds were noted. In Gapan fifteen Cabanis's weavers were collected in a field of rice in head. Two of the stomachs were empty. Rice was found in eight stomachs, in six of which it was mixed with weeds. Amor seco and daua-dauahan were the weeds noted.

Thirteen stomachs of this weaver were studied from the municipalities of Bamban, Capas, and Murcia in Tarlac Province. Rice was recovered in all six stomachs obtained in Bamban. In Capas two of five stomachs were empty. Rice was recorded in three stomachs, in one of which the grain was mixed with a species of weed known as malakauayan (*Panicum reptans* Linn.). Rice was recovered from the two stomachs of weavers secured at Murcia.

An estimate made of the data obtained from the material secured in October, 1932, shows that ten species of weeds comprised 98.82 per cent of the food. The balance of 1.18 per cent was represented by rice. Amor seco and daua-dauahan were the two most important food items for the month, as they represented 69.17 per cent and 26.93 per cent, respectively, of the weed seeds eaten.

For November, 1932, fifty-six birds were collected in Maketipo, Novaliches, and San Pedro Makati, all in Rizal Province, when rice was ready for harvest. From Maketipo twelve stomachs were examined. From six of these rice was recovered; three contained weed seeds in addition. Weeds were recorded from eight stomachs. One stomach was empty. All fifteen stomachs obtained from Novaliches contained rice and weeds in combination. Twenty-nine stomachs were studied from San Pedro Makati. Rice was noted in twenty-four of them, while weeds were observed in eleven. Deviation from the total number is due to two empty stomachs and the combination of rice and weed seeds in nine stomachs.

The data obtained yielded the following results: Rice, 20.23 per cent; weed seeds, 79.77 per cent. Amor seco and daua-dauahan were the two important weed items, constituting 56.90 per cent and 39.36 per cent, respectively, of the weed seeds eaten.

The birds studied for December, 1932, were obtained from widely scattered regions.

The food of twelve birds from two collecting places in Novaliches, Rizal Province, were studied. Rice was noted in nine, in six of which the grain was mixed with weed seeds. Two stomachs contained nothing but weed seeds. One was empty.

In Alabang, Rizal Province, fifteen weavers were obtained while rice was being harvested. Rice was secured from seven stomachs. Weed seeds were noted in twelve stomachs, in five of which they were mixed with rice. One was empty.

A bird caught in a newly harvested rice field in Infanta, Pangasinan Province, had rice, amor seco, and daua-dauahan, in its stomach.

Four birds secured in a newly harvested rice field in Subic, Zambales Province, had fed exclusively on rice.

The results of the examination of thirty-two stomachs of Cabanis's weavers collected in December, 1932, in Rizal, Zambales, and Pangasinan Provinces are as follows: Rice, 12.93 per cent; seeds of five species of weeds, 87.07 per cent.

Cabanis's weavers for January, 1933, were obtained on rice stacks in San Pedro Makati, Rizal Province. The birds were observed feeding on the stored grain. Five stomachs were examined, and rice mixed with weed seeds was found in all of these. Numerically, rice constituted 17.42 per cent and amor seco, 82.58 per cent.

The stomach of a bird obtained in a newly harvested rice field in San Pedro, Laguna, in January, 1934, contained 15.84 per cent rice and 84.16 per cent weed seeds.

In February, 1933, sixty-five stomachs of birds collected in Rizal, Bulacan, and Pampanga Provinces were studied. All four birds from San Pedro Makati, Rizal, had fed on rice. They were shot on a rice stack.

In Bulacan collecting for the month was done in Baliuag and Pulilan. Rice was noted in eleven of the twelve stomachs from Baliuag. One was empty. Weed seeds, chiefly of amor seco, were found in combination with rice in six stomachs. The twelve birds from Pulilan had rice in their stomachs. In six stomachs rice was mixed with weeds.

In Pampanga birds for this month were taken at Apalit and San Luis. The stomachs of thirty-one birds collected in a newly harvested rice field in Apalit were studied. Rice was recovered from twenty-two of that number, including seventeen where it was mixed with weed seeds. Weed seeds, principally daua-dauahan, were noted in twenty-six stomachs. Five of the six weavers shot in a newly harvested rice field in San Luis had fed exclusively on rice. One had nothing but daua-dauahan in its stomach.

An estimate based on the data obtained in February, 1933, indicated that rice made up 12.41 per cent of the food, and the balance of 87.59 per cent was represented by weed seeds. Daua-dauahan and amor seco were the important weed foods for this month.

Two of four birds shot in Baliuag, Bulacan Province, in March, 1933, had a mixture of rice and weed seeds in their stomachs. The stomachs of two others were empty. The figures for this month show that 75 per cent of the food taken was rice, while weed seeds constituted 25 per cent.

Rather extensive collecting was done in March, 1934, when eighty-two stomachs from Laguna and Rizal Provinces were examined. In Laguna the birds were obtained from Pansol, Calamba, Cabuyao, Biñan, and San Pedro.

Of the eight birds collected in Pansol, five had fed on rice. In two of these the grain was mixed with weed seeds. Weed seeds were also recorded from others. Birds shot near a rice field in Calamba had largely fed on rice. Eighteen birds were obtained, and the stomachs of all except one contained rice. Weed seeds were noted in seven stomachs. Six birds obtained in Cabuyao had fed on a mixture of rice and weed seeds. From Biñan thirteen birds were secured for study during the month. All had eaten rice. Weed seeds were recovered, in addition to rice, in nine stomachs. In all twenty-three stomachs collected from San Pedro rice was recorded. Weed seeds were mixed with rice in nine of these.

In Rizal Province the materials were obtained from Muntinlupa. One stomach was empty, while thirteen weavers from Muntinlupa had fed on rice. In addition to rice, weed seeds were also noted in eleven stomachs.

Stomachs of weavers collected in March, 1934, contained 28.08 per cent rice, while seeds of seven species of weeds represented 71.92 per cent. The recovery of rice seeds in the stomachs of many birds, particularly those collected in Calamba, Cabuyao, Biñan, and San Pedro, all in Laguna Province, may be attributed to the fact that the grain was in head in those places.

Only one bird was secured for this study in Alabang, Rizal Province, in April, 1933. Its stomach contained seven seeds of rice.

In April, 1934, twenty-two birds were collected in Cabuyao, Laguna Province, and Alabang, Rizal Province. Eight of fourteen birds from Cabuyao had fed on rice, seven of which had also taken weed seeds. Six had fed exclusively on tiribuhan. All eight birds from Alabang had fed on tiribuhan. In addition, two birds had also taken rice.

The records for this month show that rice made up 1.76 per cent and weed seeds constituted the balance of 98.24 per cent. Of the weed seeds, tiribuhan constituted 92.18 per cent, amor seco representing the balance of 7.82 per cent.

The data for May, 1933, were obtained from Rizal, Laguna, Bulacan, and Pampanga Provinces.

One bird from Novaliches, Rizal Province, had taken rice entirely.

Three of the birds from Los Baños, Laguna Province, had both rice and weed seeds in their stomachs. One stomach was empty.

Six of eight stomachs from Baliuag, Bulacan, contained rice. Weed seeds were noted also in six stomachs.

All four birds collected in Apalit, Pampanga Province, during this month had fed on rice. In addition, two of the stomachs contained amor seco. These records show that the food of the birds examined for this month consisted of 19.06 per cent rice and 80.94 per cent weed seeds.

Numerically, the stomach contents of eight hundred birds which were collected from over one hundred places in forty-one municipalities belonging to ten provinces during a period of eighteen months in three years were 3.91 per cent rice and 96.01 per cent weed seeds (seeds of a species of wild bamboo recovered in one stomach included in the latter item). The economic value of weed seeds has been discussed in a previous paper (Manuel, 1934) wherein it was also indicated that the birds feeding on weed were of neutral importance.

Field observations revealed that flocks of Cabanis's weavers oftentimes with Philippine weavers frequent rice fields when the grain is in head. This is confirmed by the results of the examination of stomachs of birds collected when the grain was about to be harvested. Visits of these birds to the fields generally occur early in the morning and late in the afternoon, obviously to evade the heat of the day. Generally, these visits cause some damage to the crop, considering that one bird can eat ninety-two seeds of rice, as was noted in this study from a bird collected in Apalit, Pampanga. In fields where panicles of daua-dauahan overgrow those of rice, weavers alight on the weed plant first. This observation proves an assertion (Manuel, 1934) regarding the relation of Philippine weavers to the rice plant as affected by this weed. A plant ordinarily harbors two or three birds. Those in excess of this number move to the closest rice plant.

## SUMMARY AND CONCLUSIONS

1. Cabanis's weaver, *Munia cabanisi* Sharpe, is one of the weaver birds condemned by rice growers in the Philippines as causing damage to crops. This bird has several vernacular names, all of them implying deafness.
2. *Munia cabanisi* is an endemic species, very likely confined to Luzon.
3. The species is monogamous. The pairs are seen together while feeding; they help each other in building the nest and in feeding their young.
4. More than one brood is produced annually by each pair.
5. Nesting occurs throughout its range and is continuous during the year, reaching its peak between late May and early August. There appears to be a localized nesting rest period sometime between October and February.
6. Nests are built from about 3 meters to about 10 meters above the ground. Nests were noted in places about 80 meters above sea level.
7. Nests are usually built in colonies. When isolated, a nest is well concealed in the thick foliage of its host plant.
8. The nest is retort-shaped and consists of two layers—an inner compact layer of fine materials and an outer layer of loosely set materials. Nest building starts from outside and proceeds inward.
9. A clutch consists of five or six eggs. Three or four young are generally hatched from one set of eggs.
10. Cabanis's weaver nestlings feed entirely on weed seeds. An average of about seventy seeds was estimated to be the content of the crop at one time.
11. Stomachs of eight hundred adult birds from ten provinces collected during eighteen months in three years were studied.
12. The food of adults consists of seeds of rice and of weeds. Numerically, the food consists of 96.01 per cent weed seeds and 3.91 per cent rice seeds.
13. Flocks of Cabanis's weavers frequently visit rice fields when this grain is in head. During this period the percentage of rice in the food of the birds is higher than at other times.

14. Where daua-dauahan overgrows rice, the bird alights on the weed plant first and prefers the seed of this weed to that of the cultivated rice plant.

The present study shows that Cabanis's weavers destroy a large quantity of weed seeds annually in Luzon where they are confined, due to the fact that weed seeds form the entire food of young weavers, which are hatched continuously. In addition weed seeds form the greater part of the food of adults. When rice is in head, however, Cabanis's weavers, to a certain extent, feed on this grain and should not be allowed to alight in the field, as repeated visits of large flocks will result in significant harm to the crop.

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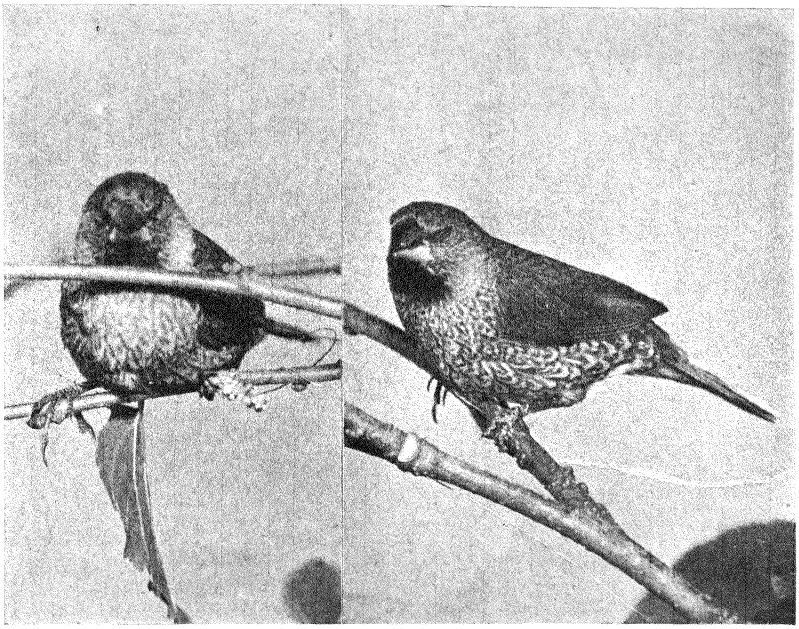
# ILLUSTRATION

## PLATE 1

FIG. 1. *Munia cabanisi* Sharpe, Cabanis's weaver, adults.
2. Nest of Cabanis's weaver.



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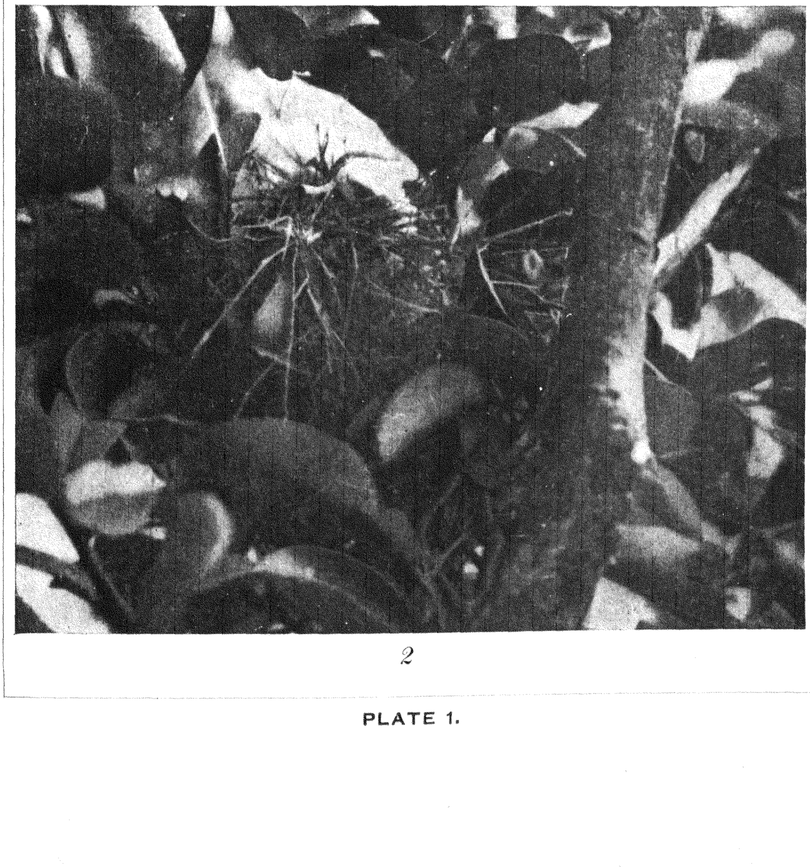

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PLATE 1.

UNIV. OF MICH.

# NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXVII[1]

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FOUR PLATES

The majority of the crane flies discussed herewith are from various parts of the Japanese Empire, including the northern Kurile Islands, Manchoukuo, Korea, the main islands of Japan, and Formosa, where they were collected by my friends Messrs. Esaki, Gressitt, Hibi, Issiki, Machida, and Miyadi. The types resulting from the above material are preserved in my collection through the continued friendly interest of the entomologists mentioned. Other species are from western China, collected by the Rev. David C. Graham, preserved in the United States National Museum; in eastern Siberia, in the Russian Academy of Sciences, received through Dr. A. von Stackelberg; and from Siam, in the American Museum of Natural History, through Dr. C. Howard Curran. I wish to express my deepest thanks to all of the above-mentioned entomologists for this further coöperation in studying the tipulid fauna of eastern Asia.

## TIPULINÆ

**CTENACROSCELIS IGNICAUDATUS** sp. nov. Plate 1, fig. 1; Plate 2, figs. 25 to 27.

Belongs to the *brobdignagius* group; mesonotal præscutum dark clove brown, with four relatively narrow grayish brown stripes; margin of præscutum dark; antenna with flagellar segments subcylindrical; pronotum dark brown above, broadly light yellow on sides; pleura chiefly yellow, with a narrow, dorsal, dark brown stripe and a small brown area on sternopleurite; femora reddish brown, the basal fifth or sixth blackened, the tip undarkened; wings with a strong reddish brown suffusion, the prearcular region darker; basal abdominal tergites dark brown, the outer segments and hypopygium brightened to fulvous.

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[1] Contribution from the entomological laboratory, Massachusetts State College.

*Male.*—Length, about 30 millimeters; wing, 38.

Frontal prolongation of head brown, more brownish black on sides; palpi black throughout; nasus distinct. Antennæ with scape and pedicel brownish yellow; basal flagellar segment slightly darker, the outer segments dark brown; flagellar segments subcylindrical (Plate 2, fig. 25), ventral face very little produced; verticils numerous, shorter than the segments. Head brown.

Pronotum dark brown above, broadly light yellow on sides. Ground color of præscutum dark clove brown, with four relatively narrow, more grayish brown stripes; margin of præscutum unbrightened; scutum dark brown, the lobes variegated by more grayish brown; scutellum brown; mediotergite paler, more grayish yellow, but uniform in color. Pleura chiefly yellow, the dorsopleural area more brightly so; a narrow dark brown dorsal stripe extending from the cervical region along the dorsal pleurites to and including the pteropleurite; a small, isolated, brown spot on sternopleurite. Halteres brownish black, the extreme base of stem reddish. Legs with the coxæ testaceous-yellow, the fore and middle coxæ more darkened; trochanters reddish brown; femora reddish brown, the basal fifth or sixth black; tibiæ and basitarsi reddish brown, the outer tarsal segments brownish black. Wings (Plate 1, fig. 1) with a strong reddish brown suffusion, the costal region and cubital and anal veins more fulvous; stigma a very little paler yellow than the ground; prearcular region more infuscated; restricted obliterative areas before cord and beyond stigma; outer branches of M and Cu, with vein 2d A, narrowly seamed with brown; axilla narrowly darkened; veins reddish brown. Venation: m-cu about equal to distal section of $Cu_1$, cell $M_4$ thus being nearly as wide as long.

Basal abdominal tergites uniformly dark brown; outer two or three segments brightened to fulvous. Male hypopygium with the tergite (Plate 2, fig. 26, 9*t*) elongate, the caudal margin with a rather shallow V-shaped emargination, the distal third of sclerite with setæ that become longer and more conspicuous on outer lateral angles but do not form distinct tuffs or pencils. Outer dististyle (Plate 2, fig. 27, *od*) shaped more or less like a dog's ear; inner style, *id*, long and slender, with abundant long erect setæ on basal third or more, the proximal end dilated. Eighth sternite (Plate 2, fig. 26, 8*s*) with very abundant sternal setæ, culminating in long yellow tufts on either side of a glabrous median emargination.

*Habitat.*—China (Szechwan).

Holotype, male, Mount Omei, altitude 5,500 to 11,000 feet, August 16 to 20, 1934 (*Graham*).

I hesitate to place this very distinct species in any of the groups defined by Edwards.[2] It fits best in the *brobdignagius* group, to which I am referring it, but with some slight question. The fly has the præscutal margins darkened and has a brown area on the sternopleurite. The black bases to the otherwise reddish brown femora are very conspicuous. In some details of coloration, the species agrees with the Oriental *Ctenacroscelis dives* (Brunetti), differing most conspicuously in the structure of the antennæ and the coloration of the legs.

**CTENACROSCELIS LIBERTUS** sp. nov. Plate 2, fig. 28.

Belongs to the *brobdignagius* group; pronotum weakly infumed on median portion, passing into orange-yellow on sides; præscutal stripes dark olive-green, bordered by slightly paler, nearly confluent; a capillary black median vitta on cephalic portion of sclerite; scutellum and mediotergite dark; pleura orange-fulvous, with a dorsal dark brown line from the cervical region to below the wing root; tips of femora dark brown; wings with a strong brownish yellow tinge; anterior prearcular field and costal region, together with stigma, darker brown; darker clouds in centers of outer medial field; abdominal tergites dark brown, basal sternites yellow; male hypopygium with the inner dististyle relatively short-stemmed, the apical beak unequally bifid.

*Male.*—Length, about 28 millimeters; wing, 33.

Frontal prolongation of head dark brown; nasus long and conspicuous; palpi dark. Antennæ with the scape brown; pedicel more brownish testaceous; flagellum broken. Head brownish gray, unmarked.

Pronotum weakly infumed on median portion, passing into orange-yellow on sides. Mesonotal præscutum rather broadly yellow laterally, the color continued around the front border of the sclerite, interrupted by a capillary black median vitta on cephalic portion of sclerite; præscutal stripes confluent or with the interspaces scarcely apparent; stripes dark olive-green, vaguely bordered by slightly paler; dark color not variegated by orange before the suture, as in *majesticus;* scutal lobes chiefly olive-green, the median area more reddish brown; scutellum dark brown; mediotergite brownish gray, with a very delicate median brown vitta. Pleura orange-fulvous, with a dark brown dorsolongitudinal stripe beginning on the cervical sclerites, crossing the propleura, dorsal anepisternum and pteropleurite, becoming more expanded surrounding the wing base; dorsopleural region extensively orange; ventral pleurites uniformly pale. Halteres black, the base of stem narrowly pale. Legs with the coxæ and trochanters pale; femora brownish yellow, the tips rather narrowly darker brown but not blackened; tibiæ yellow, the tips more narrowly dark brown; tarsi passing into black; claws (male) toothed. Wings with a strong brownish yellow tinge, the anterior prearcular field and costal border darker, best evidenced by the black veins of the prearcular field; stigmal area about as dark as the costal border; somewhat darker clouds in outer end of cell M and as centers to the outer medial cells, this coloration possibly abnormal and in any case discolored by a purplish stain in the unique type; anterior and posterior cord weakly bordered by darker; veins brownish yellow. Venation: Cell $M_1$ short-petiolate, the petiole only about one-third of m; m-cu very close to fork of $M_{3+4}$, subequal to distal section of $Cu_1$, cell $M_4$ thus markedly deeper than in *fulvolateralis*.

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[2] Stylops 1 (1932) 145–146.

Abdominal tergites dark brown, the basal sternites abruptly light yellow. Male hypopygium with the ninth tergite (Plate 2, fig. 28, 9*t*,) having a shallow V-shaped notch, the lateral lobes obtuse; on dorsal surface of each lobe a second lower lobule with a brush of setæ distinct from the group at apex of the lobe itself. Outer dististyle, *od*, with the apex obtuse. Inner dististyle, *id*, with the stem relatively short and stout, the apex dilated, in profile appearing somewhat like a flamingo's head; additional to the primary decurved hooklike point is a smaller lateral one; at base of stem a dilated lobe, with coarse erect setæ. Eighth sternite rather strongly produced ventrad; caudal margin transverse or convexly rounded, with inconspicuous groups of yellow setæ on outer lateral portions, these lines continued cephalad on face of sclerite.

*Habitat.*—China (Szechwan).

Holotype, male, Wei Chow, 65 miles northwest of Chengtu, altitude 5,000 to 8,000 feet, July 25, 1933 (*Graham*).

The nearest allies of the present species are *Ctenacroscelis fulvolateralis* (Brunetti) and *C. majesticus* (Brunetti), of the Himalayan region of northern India. The latter species differs in the structure of the hypopygium and in details of coloration, especially the lack of a brown pleural stripe and the presence of a conspicuous orange spot on the præscutum before the suture.

From *fulvolateralis,* the present fly differs in the coloration of the body, femora, and wings and in the details of venation.

**CTENACROSCELIS QUADRIFASCICULATUS** sp. nov. Plate 1, fig. 2; Plate 2, figs. 29 and 30.

Belongs to the *serratus* group; mesonotal præscutum olive, with three more greenish stripes; scutellum and mediotergite orange; pleura orange-fulvous, with a conspicuous whitish longitudinal stripe; trochanters black; femora bright reddish, their bases narrowly blackened; wings fulvous-brown; cell $M_1$ short-petiolate; abdominal tergites dark reddish brown; male hypopygium with the sternite and basistyle only slightly produced, the latter emarginate at apex, each lobe with brushes of long, yellow setæ.

*Male.*—Length, about 25 millimeters; wing, 31.5.

Frontal prolongation of head long and slender, considerably exceeding the remainder of head, reddish brown, darker on sides; nasus conspicuous, depressed. Antennæ with scape and pedicel brown, the flagellum somewhat paler brown; first flagellar segment long and slender (Plate 2, fig. 29), subequal to the scape; intermediate flagellar segments strongly produced on ventral surface, much as in *serratus,* the serration most strongly developed on flagellar segments three to six, inclusive. Head grayish brown, the anterior vertex clearer gray.

Pronotum dark brown medially above, paler on sides. Ground color of præscutum olive, with three even more greenish stripes that are narrowly bordered by more grayish; lateral borders of præscutum castaneous; scutal lobes greenish, the median area restrictedly yellow; scutellum and mediotergite orange, the latter more whitish on posterior half. Pleura with the ground color orange-fulvous, with a conspicuous whitish longitudinal stripe, extending from behind the fore coxæ to the base of abdomen, widened posteriorly, narrowly bordered above on anepisternum and more extensively along ventral edge by darker brown; dorsopleural membrane pale. Halteres brownish black, the base of stem restrictedly reddish. Legs with the coxæ chestnut, the middle and hind pair paler at tips; trochanters black; femora bright reddish, the bases narrowly blackened, the tips scarcely darker; tarsi broken beyond second segment, the basal portion light brown. Wings (Plate 1, fig. 2) with a strong fulvous brown tinge, cell Sc clearer yellow; centers of the cells somewhat paler; wing base narrowly blackened; veins bright yellow. Venation: Cell $M_1$ with petiole about one-half m.

Abdominal tergites with basal two segments chestnut-brown, the lateral borders narrowly pale; median line of first tergite yellow; outer segments somewhat darker reddish brown. Male hypopygium (Plate 2, fig. 30) with the tergite, *9t*, relatively short, the median notch shallower than in *serricornis*, the lateral lobes obliquely truncated, with abundant erect black setæ. Basistyle, *b*, not long-produced, the apex deeply emarginate to form two lobes, the upper or more dorsal a little more truncated, both lobes with brushes of long yellow setæ. Outer dististyle, *od*, moderately wide. Inner dististyle, *id*, long and slender, the apex suddenly narrowed, curved, set with five or six erect spines. Eighth sternite, *8s*, without special armature.

*Habitat.*—China (Szechwan-Tibet Border).

Holotype, male, Mupin, altitude 3,500 feet, June, 1929 (*Graham*).

The present fly is most readily told from *Ctenacroscelis serricornis* (Brunetti) by the structure of the male hypopygium, especially the long hair brushes at apex of each basistyle.

**CTENACROSCELIS REGIUS** sp. nov. Plate 2, fig. 31.

General coloration of head and thorax orange, the latter unmarked except for four pale brownish gray stripes on præscutum and similarly colored areas on scutal lobes; flagellar segments cylindrical or virtually so, with short verticils; wings long and narrow, deep fulvous, the small stigmal area slightly more yellowish; cell $M_1$ petiolate; abdominal tergites chiefly brown; ovipositor with the cerci gently decurved at tips.

*Female.*—Length, about 45 millimeters; wing, 48.5 by 8.

Frontal prolongation of head relatively long, deep orange; nasus unusually long, subequal in length to the antennal scape; palpi with basal three segments brown, the incisures of the second and third segments restrictedly pale; terminal segment black. Antennæ yellowish orange, the outer flagellar segments scarcely darker; flagellar segments cylindrical or virtually so (Plate 2, fig. 31); setæ abundant but short, the terminal two segments with the setæ longer and more conspicuous. Head deep orange; vertical tubercle low, entire.

Pronotum orange. Mesonotal præscutum orange with four pale brownish gray stripes that are little-apparent against the ground, the mesal margins of the intermediate pair narrowly bordered by brown, more intense in front; posterior sclerites of notum orange or orange-fulvous, each scutal lobe with two confluent pale brownish gray areas. Pleura uniformly yellow. Halteres brown, the base of stem narrowly orange. Legs with the coxæ and trochanters yellow; femora orange, the tips very insensibly more fulvous, the ctenidium black; tibiæ and tarsi orange, the terminal tarsal segments passing into dark brown. Wings long and narrow, as shown by the measurements, the width almost uniform for most of the length; membrane deep fulvous, the small stigmal area slightly more yellowish; veins horn yellow. Venation: Rs subequal to $R_{2+3}$; r-m a little shorter than the basal section of $R_{4+5}$; petiole of cell $M_1$ exceeding one-half m; m-cu a short distance before fork of $M_{3+4}$, slightly longer than the distal section of $Cu_1$; basal third of cell 2d A lying proximad of level of arculus.

Abdomen with sides of first tergite yellow, the median area and succeeding tergites medium brown, the lateral borders a trifle more grayish, bordered internally by vague dusky lines, more evident on the subterminal segments; sternites a trifle more yellowish brown. Ovipositor with the cerci deep castaneous, blackened basally, the tips gently decurved.

*Habitat.*—Siam.

Holotype, female, Chieng-mai, October 27, 1920 (in American Museum of Natural History).

The nearest ally of the present fly seems to be *Ctenacroscelis rex* Alexander, of Burma,[3] which differs most evidently in the grayish black præscutal stripes and similarly colored areas on the scutal lobes. I cannot place the present fly in any of the groups of the genus defined by Edwards.[4] In its major size it agrees with the *brobdignagius* group but differs in all details of coloration, while the long conspicuous nasus excludes it from the *monochrous* group. Because of lack of specimens I cannot say whether or not *Ctenacroscelis rex* has the nasus present or lacking. In the present fly it is unusually long and powerfully constructed.

### TIPULA (VESTIPLEX) EXCISOIDES Alexander.

*Tipula* (*Vestiplex*) *excisoides* ALEXANDER, Philip. Journ. Sci. 52 (1933) 398–399.

Described from various stations in Kamchatka. One male, Lake Yôda, Paramushir Island, northern Kurile Islands, Japan, July 14, 1934 (*D. Miyadi*), in the Otsu Hydrobiological Station Laboratory, Otsu, Japan.

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[3] Insec. Inscit. Menst. 5 (1917) 21–23.

[4] Loc. cit.

**TIPULA (ARCTOTIPULA) MIYADII** sp. nov. Plate 1, fig. 3; Plate 2, fig. 32.

General coloration (in alcoholic specimens) black, probably pruinose in fresh specimens; antennæ black throughout; wings tinged with brownish, the long-oval stigma brownish black, very conspicuous; cell $M_1$ petiolate; abdomen uniformly dark in male, the intermediate segments in female very narrowly ringed caudally with pale; male hypopygium with the lateral lobes of tergite truncate, the median notch deep, U-shaped; apical beak of inner dististyle very slender.

*Male.*—Length, about 15 millimeters; wing, 15.5; antenna, about 3.5.

*Female.*—Length, about 20 millimeters; wing, 20.

Described from alcoholic specimens.

Frontal prolongation of head and palpi black, the incisures of the latter restrictedly pale; nasus very long and conspicuous. Antennæ black throughout, short in both sexes; flagellar segments short-cylindrical, without well-defined basal enlargements; verticils longer than the segments. Head gray, with long conspicuous setæ.

Thorax (in alcohol) uniformly dark, in dry specimens presumably pruinose; it cannot be stated that the præscutum is or is not striped. Halteres dusky, the knobs slightly more darkened. Legs with coxæ and trochanters black, pruinose; femora obscure yellow basally, the outer third or so darker, the tips black; tibiæ and basitarsi brown basally, the tips black; remainder of tarsi black. Wings (Plate 1, fig. 3) tinged with brownish, the long-oval stigma brownish black; restricted obliterative areas before and beyond stigma and across base of cell 1st $M_2$; very vague to scarcely indicated darker seams along cord and on veins beyond cord; veins brownish black to black. Venation: $Sc_1$ represented by a weak spur some distance before end of $Sc_2$; petiole of cell $M_1$ subequal to m; distal section of $Cu_1$ curved rather strongly to the anal angle of wing.

Abdomen uniformly dark in male, in female with the extreme caudal borders of the intermediate segments paler; hypopygium dark. Male hypopygium with the tergite (Plate 2, fig. 32, 9*t*) slightly longer than broad, the caudal margin with a deep U-shaped median notch; lateral lobes truncate; no lobule at base of median incision. Outer dististyle, *od*, flattened, more or less shaped like a human sole, the outer end narrowed. Inner dististyle, *id*, with the spine at near midlength of outer face powerful, acute; apex of beak of style slender, the tip narrowly obtuse.

*Habitat.*—Japan (Kurile Islands).

Holotype, alcoholic male, Lake Yôda, Paramushir Island, July 14, 1934 (*D. Miyadi*). Allotopotype, alcoholic female, in collection of the Otsu Hydrobiological Station, Otsu, Japan.

I take great pleasure in naming this distinct species of *Arctotipula* in honor of the collector, Dr. D. Miyadi, to whom I am indebted for the opportunity of examining a small series of crane flies from the northern Kurile Islands. The nearest allies are *Tipula* (*Arctotipula*) *salicetorum* Siebke (*nigricornis* Zetterstedt, preoccupied; *zetterstedti* Strobl, renaming of last) of northern Europe; *T.* (*A.*) *alascænsis* Alexander (Pribilof Islands, Alaska), and *T.* (*A.*) *hirtitergata* Alexander (northeastern Asia). The first-named species has a very different hypopygium.[5] The two last-named species differ in the general coloration of the wings and legs, and, especially, in the structure of the male hypopygium, notably the broadly expanded apex or beak of the inner dististyle.

**TIPULA (SCHUMMELIA) STIPATA** sp. nov. Plate 1, fig. 4; Plate 2, fig. 33.

Belongs to the *continuata* group; allied to *bidenticulata;* male hypopygium with the caudal end of the inner dististyle produced backward into a broad compressed blade, its caudal end weakly emarginate.

*Male.*—Length, about 12 millimeters; wing, 13.

*Female.*—Length, about 11 to 12 millimeters; wing, 13 to 14.

Frontal prolongation of head yellow above, dark brown on sides; palpi black. Antennæ with the scape and pedicel yellow; basal segments of flagellum weakly bicolorous, the basal enlargements brownish black, the remainder of each segment somewhat paler, yellowish brown. In female the flagellum is conspicuously bicolorous, dark brown and light yellow. Head yellow, the posterior vertex more cinnamon brown on either side of the broad yellow median line.

Pronotum yellow medially, variegated with dark brown on sides. Mesonotal præscutum yellow, with three conspicuous brown stripes, the median one very narrowly split by a vaguely paler line; lateral borders of sclerite and posterior interspaces more or less suffused with dusky; median area of mesonotum behind the suture broadly yellow, the lateral portions dark brown, including the scutal lobes, parascutella and sides of mediotergite. Pleura yellow, more or less variegated by brown on anepisternum, ventral sternopleurite and meron; cervical region and propleura conspicuously darkened. Halteres with stem obscure yellow, the base of knob infuscated, the apex broadly yellow. Legs with the coxæ testaceous-yellow, the posterior pair in cases a little darkened at bases; trochanters yellow; femora yellow, the tips rather narrowly but conspicuously blackened; tibiæ yellowish brown, the tips narrowly darker; tarsi passing through brown to brownish black. Wings (Plate 1, fig. 4) subhyaline; cell Sc infumed, cell C yellow; stigma dark brown, conspicuous; broad brown seams on m-cu and distal section of vein $Cu_1$; weak darkened clouds in outer radial field and outer discal portion of cell 1st A; more yellowish areas before and beyond stigma and across cell 1st $M_2$; veins brown. Venation: $R_{1+2}$ pale, with macrotrichia on basal half or more; cell 1st $M_2$ small; basal sections of $M_{1+2}$ and $M_3$ so pale as to be virtually obliterated; petiole of cell $M_1$ more than twice m, usually several times this length.

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[5] Lundström, C., Acta Soc. Fauna Flora Fennica 29 No. 2 (1907) pl. 1, fig. 10; Lackschewitz, P., Norsk Entomologisk Tidskrift 3 (1933) 258, pl. 2, fig. 6.

Abdominal segments yellow basally, the outer ends broadly brown to dark brown, in cases more uniformly darkened. Male hypopygium with the caudal margin of tergite (Plate 2, fig. 33, 9*t*), as viewed from above, very gently emarginate; on ventral surface with a low, obtuse, median, blackened lobe and longer, subacute, spinous, lateral points, invisible from above. Outer dististyle long, gradually narrowed outwardly. Inner dististyle, *id*, compact, with the posterior or caudal end produced backward into a broad, compressed blade that bears numerous setæ; this extension is somewhat as in *bidenticulata* and *nipponensis*, yet quite distinct in conformation.

*Habitat*.—Japan (Saghalien).

Holotype, male, Takinosawa, July 26, 1922 (*Esaki*). Allotype, female, Nodosam, July 30, 1922 (*Esaki*). Paratype, female, Konuma, July 21, 1922 (*Esaki*).

I had earlier misdetermined this material as being *Tipula nipponensis* Alexander.[6] The nearest ally is *Tipula* (*Schummelia*) *bidenticulata* Alexander, which differs especially in the structure of the inner dististyle of the hypopygium and in the wing pattern and venation, as the larger cell 1st $M_2$.

[6] Philip. Journ. Sci. 24 (1924) 604.

**TIPULA (OREOMYZA) MALAISEI Alexander.**

*Tipula malaisei* ALEXANDER, Arkiv för Zoologi, Band 19 A, No. 9 (1927) 6–8, fig. 3.

Described from Petropavlovsk, Kamchatka, July 13 and 14, 1922 (*R. Malaise*). Two females, Lake Sue-Bettobu 26, Shumshir Island, northern Kurile Islands, Japan, July 22, 1934 (*Miyadi*); Otsu Hydrobiological Laboratory, Otsu, Japan.

**TIPULA (LUNATIPULA) JUSTA sp. nov.** Plate 1, fig. 5; Plate 2, fig. 34.

Belongs to the *variipetiolaris* group; size large (wing over 20 millimeters); mesonotal præscutum with a clear gray median stripe that is narrowly bordered by dark brown; wings brown, striped longitudinally with white; male hypopygium with the inner dististyle gradually diverging outwardly; eighth sternite with the median lobe long-triangular in outline.

*Male.*—Length, 17 to 19 millimeters; wing, 22 to 24.5.

Frontal prolongation of head relatively long, dark reddish brown; nasus lacking; palpi brown, the last segment black. Antennæ with scape and pedicel fulvous; flagellum dark brown, the basal enlargement slightly developed; longest verticils exceeding the segments. Head gray.

Pronotum brown, darker laterally. Mesonotal præscutum with the median stripe clear gray, bordered laterally by dark brown, the margins becoming narrower and finally obsolete behind; posterior interspaces slightly clearer ashen-gray than the median stripe; lateral stripes, and humeral and lateral borders of sclerite, more infumed, the extreme lateral margin still darker; posterior sclerites of mesonotum dull gray, the mediotergite with indications of a capillary darker vitta. Pleura chiefly gray, variegated by slightly more brownish areas; dorsopleural membrane infuscated, more strongly so behind. Halteres dusky, the knobs dark brown. Legs with the coxæ and trochanters brownish gray; femora brownish yellow, the tips narrowly blackened; tibiæ brownish yellow, the tips more narrowly infuscated; tarsi pale basally, passing into black. Wings (Plate 1, fig. 5) with a strong brown tinge, striped longitudinally with whitish, the latter including streaks in the anal cells; outer end of cell R and a broad continuous line from cell 1st $M_2$ to the wing tip, involving portions of cells $R_5$, $M_1$, and 2d $M_2$; restricted obliterative areas before and beyond stigma; base of cell $M_3$ pale, sending an extension to margin along vein $M_4$; restricted darker brown areas include the stigma, tip of $Sc_2$, origin of Rs and cord; veins dark, paler in the more brownish yellow costal region. Venation: Cell $Sc_2$ relatively long, due to the length of the free tip of $Sc_2$; cell $M_1$ petiolate, this subequal to or longer than m.

Abdominal tergites obscure yellow, narrowly trivittate with dark brown, the stripes continuous or nearly so; lateral borders of tergites more grayish; hypopygium more uniformly brown. Male hypopygium with the tergite (Plate 2, fig. 34, 9*t*) having the median point acute, subtended by a few setæ. Inner dististyle, *id,* not parallel-sided, as in *variipetiolaris,* gradually diverging outwardly. Eighth sternite, 8*s*, with median lobe long-triangular in outline, not expanded distally, as in *minensis.*

*Habitat.*—China (Szechwan).

Holotype, male, Wei Chow, 65 miles northwest of Chengtu, altitude 9,000 to 12,500 feet, August 15, 1933 (*Graham*). Paratopotypes, 2 males, altitude 15,200 feet, August 14, 1933 (*Graham*).

The nearest relatives of the present species are *Tipula* (*Lunatipula*) *minensis* Alexander and *T.* (*L.*) *variipetiolaris* Alexander, which differ especially in the hypopygial structure, as discussed above. In stature the present fly agrees more nearly with *minensis.* The length of the petiole of cell $M_1$ does not show the variation evidenced in *variipetiolaris.*

**NEPHROTOMA INTEGRA** sp. nov. Plate 1, fig. 6; Plate 3, fig. 35.

Mesonotal præscutum obscure reddish yellow, with three polished brownish black stripes that are not bordered by a different color; mediotergite dark, with a median yellow triangle; antennæ elongate, flagellum black; wings brownish yellow, the wing tip broadly darkened; abdomen yellow, the tergites with broad, brownish black triangles; eighth sternite darkened; male hypopygium with the median area of tergite entire; basistyle with a blackened bifid lobe; inner dististyle with a high glabrous vertical crest; ninth sternite with a median pubescent lobe.

*Male.*—Length, about 12 to 13 millimeters; wing, 10 to 12.5; antenna, about 5.8 to 6.8.

*Female.*—Length, about 15 millimeters; wing, 12.

Frontal prolongation of head yellow, the outer half of dorsal surface, together with the nasus, more or less infuscated; palpi brownish black. Antennæ (male) relatively elongate, as shown by the measurements; scape obscure yellow; pedicel and basal segment of flagellum brownish yellow; remainder of flagellum black, the elongate segments rather strongly incised, the verticils shorter than the segments. Head orange; a small, dark, orbital spot at narrowest point of anterior vertex; occipital brand very small, undifferentiated from the ground.

Pronotum obscure yellow medially, dark brown on sides. Anterior lateral pretergites pale yellow. Mesonotal præscutum obscure reddish yellow, with three polished brownish black to black stripes, the median one with a more reddish median line; stripes not margined with another color; scutum yellow medially, the lobes solidly brownish black; scutellum obscure brownish yellow, the parascutella dark brown; mediotergite dark brown with a central yellow triangle, the point directed backward. Pleura very pale yellow, variegated with reddish brown on ventral anepisternum, ventral sternopleurite and meron, and dorsal portion of pleurotergite. Halteres with stem brownish yellow, the base of knob dark brown, the apex obscure yellow. Legs with fore coxæ darkened on anterior faces, remainder of coxæ and all trochanters yellow; femora yellowish brown, the bases clearer yellow, the extreme tips blackened; tibiæ pale brown, the tips narrowly darkened; tarsi brownish black to black. Wings (Plate 1, fig. 6) with a strong brownish yellow tinge, cells C and Sc somewhat darker; stigma dark brown; brown seams along cord and outer end of cell 1st $M_2$; wing tip broadly brown, the color extending basad almost to level of outer end of cell 1st $M_2$, especially along the veins; veins brown. Stigmal trichia variable, from eight to twenty-five in number, all in cell $R_1$. Venation: Cell $M_1$ sessile; m-cu at or close to fork of $M_4$, the latter shortly before $M_3$.

Abdominal tergites yellow, the segments with broad, posterior, brownish black triangles, on the outer segments becoming more transverse, bandlike; lateral borders of tergites with a darkened spot at near midlength; sternites with posterior margins more narrowly darkened, the eighth sternite chiefly blackened; hypopygium reddish yellow. Male hypopygium with the lateral horns of tergite (Plate 3, fig. 35, *9t*) relatively broad; median tergal area entire, transverse, with weak spines and setæ on lateral portions only. Basistyle with a blackened lobe that is more or less bifid at tip. Outer dististyle, *od,* relatively narrow, extended into a long slender point. Inner dististyle, *id,* with a high, vertical, glabrous crest; beak slender. Ninth sternite with a median fingerlike lobe, directed ventrad, the lobe with abundant delicate setulæ. Eighth sternite with a shallow median notch, the adjacent portions of the lobes with numerous long setæ that are directed caudad and mesad. Penis stout.

*Habitat.*—Formosa.

Holotype, male, Rokki, altitude 1,000 feet, May 16, 1934 (*Gressitt*). Allotopotype, female, pinned with the type. Paratopotypes, 2 males, 1 female.

The coloration of the posterior sclerites of the mesonotum indicates that the present fly is allied to species of the *palloris* group, but the coloration of the præscutum and structure of the male hypopygium are very different from all described members of that group. The blackened bifid lobe on the basistyle of the male hypopygium is very similar to that found in *Nephrotoma biarmigera* Alexander (eastern China), which is otherwise an entirely different fly.

**NEPHROTOMA ESAKII Alexander. Plate 1, fig. 7; Plate 3, fig. 36.**

*Nephrotoma esakii* ALEXANDER, Philip. Journ. Sci. 24 (1924) 596–597.

Described from Kamiotoineppu, Hokkaido, Japan, August 25, 1922 (*Esaki*). Additional specimens: Sapporo, Hokkaido, July 23, 1924 (*M. Hori*); 1 male, Yumoto, Shimotsuke, Honshiu, Japan, altitude 5,000 feet, August 6, 1934 (*Issiki*).

The venation is shown (Plate 1, fig. 7). The male hypopygium is somewhat peculiar and may be described as follows: Ninth tergite (Plate 3, fig. 36, 9*t*) deeply and acutely notched medially, the lateral lobes obtuse. Outer dististyle, *od*, entirely blackened, elongate, gently arcuate, more or less boomerang-shaped. Inner dististyle, *id*, with the beak stout; crest erect. Membrane between the eighth and ninth sternites with a conspicuous depressed lobe shaped about as shown in the figure, 9*s*. Eighth sternite with the median area of posterior border without setæ, the remainder of sclerite with long, conspicuous, black setæ.

**NEPHROTOMA SERRISTYLA sp. nov. Plate 1, fig. 8; Plate 3, fig. 37.**

General coloration of mesonotal præscutum yellow, with three polished, reddish ferruginous stripes; lateral ends of suture broadly and conspicuously black; antennæ (male) relatively long, the basal flagellar segments bicolorous; head orange-yellow, without occipital brand; pronotum entirely light yellow; wings weakly tinged with brown, the stigma slightly darker brown; male hypopygium with the inner dististyle bearing a conspicuous serrate crest, the apical beak slender, black; membrane between eighth and ninth sternites with a prow-shaped orange lobe.

*Male.*—Length, 10 to 11 millimeters; wing, 10.5 to 11.

*Female.*—Length, 13 to 14 millimeters; wing, 12 to 13.

Frontal prolongation of head, including nasus, yellow; palpi obscure yellow throughout. Antennæ (male) relatively long and stout, if bent backward extending approximately to base of abdomen; basal three segments yellow, the succeeding three or four segments bicolorous, dark brown basally, the remainder yellowish brown; outer flagellar segments uniformly brownish black; flagellar segments rather strongly incised. In female the short antennæ are less evidently bicolorous. Head orange-yellow, without evident occipital brand.

Pronotum entirely light yellow. Mesonotal præscutum yellow, with three, polished, reddish ferruginous stripes that are not bordered or variegated by other colors, except that in certain specimens the median stripe is somewhat paler in its central portion; lateral end of suture and lateral borders of scutal lobes intensely black; scutum yellow medially, the lobes extensively reddish ferruginous; scutellum testaceous-brown, the parascutella yellow; mediotergite uniformly yellow. Pleura yellow, the ventral anepisternum and sternopleurite, and dorsal and posterior pleurotergite slightly more reddish. Halteres dusky, the knobs faintly obscure yellow. Legs with the coxæ and trochanters yellow; femora and tibiæ yellow, the tips very narrowly and inconspicuously darkened; tarsi passing through brown to black. Wings (Plate 1, fig. 8) with a weak brown tinge; stigma oval, slightly darker brown; veins brown. A few scattered stigmal trichia in cell $R_1$. Venation: $Sc_2$ ending a short distance beyond origin of Rs, $Sc_1$ weakly preserved; cell $M_1$ short-petiolate to sessile; m-cu close to fork of $M_4$, the latter some distance before fork of $M_3$.

Abdomen orange-yellow, the tergites very weakly darkened before suture; in cases, the subterminal segments darkened; hypopygium yellow. Male hypopygium with the lateral horns of tergite (Plate 3, fig. 37, 9*t*) acute, unarmed with blackened spines except at extreme base. Outer dististyle, *od*, pale, the apical third attenuate. Inner dististyle, *id*, with the apical beak slender, intensely blackened; dorsal crest broad and extensive, the margin produced into several pale points. Membrane between eighth and ninth sternites with a small prow-shaped lobe, orange in color.

*Habitat.*—China, eastern Siberia.

Holotype, male, Chungking, Szechwan, China, altitude 1,000 to 2,000 feet, May 6 to 27, 1930 (*Graham*). Allotopotype, female. Paratopotypes, 6 males and females; paratype, 1 male, Kotikowo Station of the Ussuri Railway, Ussuri Province, eastern Siberia, July 26, 1927 (*Stackelberg*).

*Nephrotoma serristyla* is most closely allied to *N. parvirostra* Alexander, differing most conspicuously in the coloration of the thorax and antennæ. The serrate dorsal crest of the inner dististyle occurs in several other species of the genus, including besides *parvirostra*, the European *N. scurra* (Meigen).

**NEPHROTOMA PROFUNDA** sp. nov. Plate 1, fig. 9; Plate 3, fig. 38.

General coloration of thorax polished yellow, the præscutum with three reddish brown stripes; antennæ short, the flagellar segments with very long verticils; wings with stigma dark brown; abdominal tergites yellow, trivittate with black; male hypopygium with the eighth sternite long, profoundly incised, the margins of the notch fringed with long yellow setæ.

*Male.*—Length, about 12.5 to 15 millimeters; wing, 11.5 to 14.

*Female.*—Length, about 16 to 18 millimeters; wing, 13 to 14.

Frontal prolongation of head varying from yellow to brown; palpi with basal segments dark brown, the outer two segments paler. Antennæ unusually short, in male if bent backward not attaining the wing root; basal three segments obscure yellow, the remainder passing into black; flagellar segments very weakly incised, the basal enlargements only feebly developed; verticils very long, exceeding the segments. Head yellow, without clearly defined occipital brand.

Pronotum darkened medially, yellow on sides. Mesonotal præscutum polished yellow, with three reddish brown stripes that are not bordered by any other color; lateral stripes straight; scutum yellow medially, the lobes extensively reddish brown; scutellum testaceous-yellow; mediotergite light yellow, with a median brown line, narrowed behind and not attaining the posterior margin. Pleura yellow, with more reddish areas on anepisternum, ventral sternopleurite, and pleurotergite. Halteres dusky, the base of stem restrictedly paler. Legs with the coxæ and trochanters yellow; femora and tibiæ yellow, the tips not or scarcely darkened; tarsi passing into brown. Wings (Plate 1, fig. 9) with the ground color yellow, cells C and Sc more saturated; stigma dark brown, conspicuous; restricted dark seams on anterior cord and wing tip; veins brown, more yellowish in prearcular and costal portions of wing. Venation: $Sc_2$ extending to a short distance beyond origin of Rs, $Sc_1$ weakly preserved; cell $M_1$ variable, from sessile to having a petiole longer than m; m-cu at fork of $M_4$ or shortly beyond base of latter.

Abdominal tergites yellow, trivittate with black, the median stripe broader; lateral stripes slightly constricted and interrupted on basal ring; median region of sternites weakly darkened; eighth segment chiefly blackened; hypopygium chiefly reddish brown. Male hypopygium with the tergite (Plate 3, fig. 38, 9*t*) having the median notch narrow. Outer dististyle, *od,* long-attenuate. Inner dististyle, *id,* with the apical beak slender; dorsal crest pale, irregularly toothed. Eighth sternite, 8*s*, long, with a very deep and acute median incision that extends cephalad to about the basal third of the sclerite; margin of incision with long, conspicuous, yellow setæ. Gonapophyses, *g*, subequal in length to ædeagus, appearing as smooth, weakly curved blades, their tips acute.

*Habitat.*—China (Szechwan).

Holotype, male, Chengtu, altitude 1,700 feet, May 10 to 14, 1933 (*Graham*). Allotopotype, female. Paratopotypes, numerous males and females.

The nearest ally is *Nephrotoma minuticornis* Alexander (Japan), which differs most conspicuously in the pale stigma of the wings and in the structure of the male hypopygium, especially of the eighth sternite.

**NEPHROTOMA BIFASCIGERA** sp. nov. Plate 1, fig. 10; Plate 3, figs. 39 and 40.

General coloration yellow, the præscutum with three black stripes, the lateral pair outcurved; antennal flagellum black; occipital brand very large; pronotum yellow medially, darkened on sides; scutellum with a linear black median dash; mediotergite with an inverted T-shaped black area; pleura spotted with black; femora yellow, the tips narrowly blackened; wings subhyaline; stigma dark brown; a narrow dark seam on anterior cord; abdominal tergites with a broad, median black stripe, the lateral borders of the segments grayish brown; a subterminal black ring; male hypopygium with the lateral horns of tergite crowned with black spines; eighth sternite broad, the lateral angles with tufts of black setæ, the median area filled with pale membrane; gonapophyses yellow, broadly flattened, the tips bispinous.

*Male.*—Length, about 11 to 11.5 millimeters; wing, 10 to 10.5.

Frontal prolongation of head light yellow, the dorsal surface with an oval or U-shaped dark brown mark, the arms directed caudad; nasus dark; palpi black, the outer segment a little brighter. Antennæ with scape reddish yellow; pedicel and base of first flagellar segment a little more brownish yellow; remainder of flagellum black; segments of moderate length and only feebly incised; longest verticils subequal to the segments. Front light sulphur yellow, the posterior portions more orange; occipital brand very large, subcircular or oval in outline, sending a narrow point cephalad almost to summit of vertical tubercle; a pale brown to darker spot near orbits behind antennal fossæ.

Pronotum light yellow, weakly infuscated on sides. Mesonotal præscutum yellow, with three subnitidous black stripes that are very narrowly bordered by a more opaque black; median stripe narrowed at posterior end and reaching the suture; lateral stripes with a paler brown spot at anterior end, giving an outcurved appearance; a narrow brown line on posterior pretergites before the suture; scutum light yellow, each lobe with two confluent black areas, leaving the median area and lateral borders broadly pale; scutellum testaceous-yellow, with a narrow, dark brown, median vitta; parascutella obscure yellow; mediotergite sulphur yellow, with an inverted T-shaped black area, the stem a little widened at anterior end. Pleura yellow, variegated with brownish black, including areas on ventral and posterior anepisternum, ventral sternopleurite, and extreme ventral meron; less-evident brown areas on dorsal and ventral pleurotergite and a small dark spot on the meropleurite. Halteres yellow, the base of knob weakly darkened. Legs with the coxæ yellow, the anterior pair slightly darker basally; trochanters yellow; femora yellow, the tips narrowly but conspicuously blackened, the amount subequal on all legs; tibiæ yellow, the tips narrowly infuscated; tarsi black. Wings (Plate 1, fig. 10) subhyaline, cells C and Sc concolorous; stigma oval, dark brown; a very narrow to scarcely evident dark seam on anterior cord; veins brown. A group of from ten to fifteen stigmal trichia in cell $R_1$. Venation: $Sc_2$ ending shortly beyond origin of Rs, $Sc_1$ preserved; cell $M_1$ subsessile to sessile; m-cu at or shortly before fork of $M_4$.

Abdominal tergites orange, with a broken, brownish black, median stripe, interrupted at posterior borders, widest and most conspicuous on the intermediate segments, becoming narrower and subobsolete on the fifth and sixth segments; lateral borders of tergites more grayish brown; segments seven to nine chiefly black, the styli yellow; sternites yellow, with a median brownish black line, in cases more extensive, leaving the posterior borders pale. Male hypopygium with the lateral arms of tergite (Plate 3, fig. 39, 9*t*) stout, crowned with numerous black spines; median incision narrow; a conspicuous U-shaped pale area on disk of tergite. Outer dististyle (Plate 3, fig. 39, *od*) moderately attenuated; setæ and punctures pale and inconspicuous. Inner dististyle, *id*, with a long, low, dorsal crest; apical beak slender. Eighth sternite (Plate 3, fig. 40, 8*s*) broad, each lateral angle a little produced and bearing a tuft of long setæ, the entire median area between these lobes filled with white membrane. Gonapophyses (Plate 3, fig. 40, *g*) appearing as broadly flattened, bispinous, yellow plates.

*Habitat.*—Eastern Siberia.

Holotype, male, Beitonovo, Amur River, Amur Province, May 28, 1915 (*Popoff*). Paratopotype, one broken male; paratype, 1 male, Osernaja, mouth of Amur River, May 31, 1910 (*W. Soldatov*); type in the Russian Academy of Sciences, Leningrad.

This fly bears a certain resemblance to *Nephrotoma virgata* (Coquillett) and traces to this species by means of keys to the local fauna. The male hypopygium is very distinctive.

**NEPHROTOMA SUBLAMELLATA sp. nov. Plate 1, fig. 11; Plate 4, fig. 41.**

*Nephrotoma lamellata* Riedel, variety; ALEXANDER, Philip. Journ. Sci. 24 (1924) 599.

Mesonotal præscutum with three feebly shining black stripes; scutellum brownish black; mediotergite yellow, with a median inverted T-shaped black area; pleura yellow, with conspicuous black markings; femora and tibiæ yellow, the tips very narrowly and insensibly darkened; wings tinged with yellow; stigma oval, dark brown, with numerous trichia; wing tip and a seam on anterior cord darkened; male hypopygium with the lateral angles of tergite produced into flattened, inwardly directed plates; gonapophyses appearing as flattened yellow blades, the outer edge and apex with microscopic serrations.

*Male.*—Length, about 14 millimeters; wing, 14.

Frontal prolongation of head light yellow, the dorsal portion on distal half, including nasus, blackened; palpi yellowish. Antennæ (male) of moderate length, if bent backward extending to the wing root or just beyond; scape and pedicel orange; first flagellar segment brown; remainder of flagellum black, the segments rather strongly incised; verticils shorter than the segments. Head orange-yellow, the occipital brand large, dark brown, its anterior margin not clearly defined; a weak infuscation on narrowest part of vertex bordering the eye.

Pronotum broadly light yellow medially, blackened on sides. Mesonotal præscutum light yellow, with three, feebly shining, black stripes that are very narrowly and insensibly bordered by darker; a large velvety black area opposite anterior end of lateral stripes; scutum yellow medially, each lobe with a large, feebly shining, black area, crossing the lateral portions of suture; scutellum brownish black, the parascutella and adjoining portions of scutal lobes light yellow; mediotergite yellow, with a median brown stripe, behind widely expanded and more blackened; scutellum and mediotergite with inconspicuous pale setæ. Pleura light yellow, conspicuously variegated with black areas on the ventral anepisternum, ventral sternopleurite, ventral meron and dorsal pleurotergite. Halteres chiefly pale reddish, the base of knob weakly suffused. Legs with the fore coxæ yellow, blackened basally, remaining coxæ and all trochanters yellow; femora and tibiæ yellow, the tips narrowly and weakly darkened; tarsi brownish black. Wings (Plate 1, fig. 11) tinged with yellow, cells C and Sc somewhat more saturated yellow; stigma oval, dark brown; wing tip narrowly but conspicuously darkened; a brown seam on anterior cord; veins brown, Sc more yellow. About fifty stigmal trichia in cell $R_1$. Venation: $Sc_2$ ending opposite to just beyond origin of Rs, $Sc_1$ represented by a short spur; cell $M_1$ very short-petiolate to barely sessile; m-cu at fork of $M_4$, the latter a short distance before $M_3$.

Abdominal tergites yellow, with three more or less distinct stripes that are somewhat obscured by abundant yellow setæ over the surface of the segments; subterminal segments blackened; hypopygium obscure yellow. Male hypopygium with the ninth tergite (Plate 4, fig. 41, 9*t*) with powerful, flattened, lateral blades, directed strongly mesad, with additional submedian flattened plates that bear the usual blackened teeth and setæ. Outer dististyle, *od*, unusually narrow, the tip attenuate. Inner dististyle, *id*, with the apical beak pale; no dorsal crest. Ninth sternite with a conspicuous protuberant horseshoe-shaped area. Eighth sternite with the caudal margin scarcely emarginate, unarmed. Gonapophyses, *g*, appearing as large, geniculate, flattened, yellow blades, the outer edge and apex weakly serrate.

*Habitat.*—Japan (Saghalien).

Holotype, male, Shimizu, July 27, 1922 (*Esaki*); in author's collection.

The nearest allies of the present species are *Nephrotoma lamellata* (Riedel) and *N. ozenumensis* Alexander, which differ in several details of coloration and structure of the male hypopygium. The yellow legs are rather distinctive in this particular group of species.

**NEPHROTOMA CHOSENSIS** sp. nov. Plate 1, fig. 12; Plate 4, fig. 42.

General coloration yellow, conspicuously patterned with black; mesonotal præscutum with three black stripes, the lateral pair outcurved to margin at anterior end; a median dark line on mediotergite; pleura conspicuously patterned with black; femoral tips narrowly blackened; wings rather strongly tinged with brownish yellow; stigma oval, dark brown; abdominal tergites with three interrupted black stripes; male hypopygium with the inner dististyle unprovided with dorsal crest; eighth sternite without lobes or setal modifications; gonapophyses appearing as elongate yellow blades.

*Male.*—Length, about 13 millimeters; wing, 12; antenna, 4.2.

Frontal prolongation of head yellow, the dorsal surface, including nasus, black; palpi brown. Antennæ of moderate length, if bent backward extending about to wing root; scape light brown; pedicel a little darker; flagellum black; flagellar segments rather strongly incised, the basal enlargement conspicuous; longest verticils subequal to the segments. Head orange, paling to yellow behind; occipital brand large, brownish black, sending an anterior prolongation to summit of vertical tubercle.

Pronotum yellow medially, black on sides. Mesonotal præscutum dirty yellow, with three polished black stripes that are not bordered by a different color; lateral stripes bent outward to margin at outer ends; a black area on lateral portion of præscutum before suture; scutum yellow, each lobe with two confluent black areas, not connected with the lateral præscutal stripes; scutellum light brown, parascutella yellow; mediotergite testaceous-yellow, with a median black stripe that narrows behind, the posterior borders of sclerite less heavily darkened. Pleura yellow, variegated with black on anepisternum, ventral sternopleurite, ventral meron, dorsocephalic portion of pteropleurite, and on pleurotergite. Halteres obscure yellow, the base of knob infuscated, the apex yellow. Legs with the coxæ yellow, blackened basally, most broadly so on forelegs, narrowest on middle coxæ; trochanters yellow; fore femora yellow basally, the outer half darkened, with a vague, obscure yellow, subterminal ring before the narrow more-blackened tips;

middle femora yellow, the tips narrowly black; tibiæ yellow, passing into brownish yellow, the tips narrowly darkened; tarsi dark brown or brownish black. Wings (Plate 1, fig. 12) rather strongly tinged with brownish yellow, cell Sc somewhat darker than cell C; stigma oval, dark brown, narrowly bordered by paler brown; a seam on anterior cord and wing tip narrowly infuscated; veins brownish black. Stigmal trichia reduced in number to four or five. Venation: $Sc_2$ ending just beyond origin of Rs, $Sc_1$ opposite this origin; cell $M_1$ short-petiolate; m-cu at fork of M.

Abdominal tergites with three broken black stripes, the median row interrupted at both base and apex of each segment: lateral stripes more complete, interrupted at posterior portions of segments; sternites yellow, diffusely infuscated medially; subterminal segments and hypopygium more extensively darkened. Male hypopygium with the lateral lobes of tergite (Plate 4, fig. 42, 9*t*) broadly truncated, separated by a deep U-shaped median notch, the margin with abundant blackened spicules, the dorsal surface with more scattered points; from ventral surface of lateral lobes on outer portion a slender spine bearing one or two blackened spicules near base. Outer dististyle, *od*, relatively small, the tip little produced, the length about two and one-half times the width. Inner dististyle, *id*, without a dorsal crest; apical beak relatively slender. Eighth sternite with caudal margin very gently emarginate, without lobes or specially modified setæ. Gonapophyses, *g*, appearing as flattened elongate blades, a little constricted beyond midlength, the tips oval, spatulate.

*Habitat.*—Korea.

Holotype, male, Kongo San, October 17, 1933 (*Machida*).

Most generally similar to *Nephrotoma contrasta* Alexander and *N. sublamellata* sp. nov., differing most evidently in the details of structure of the male hypopygium.

**NEPHROTOMA MARTYNOVI** sp. nov. Plate 1, fig. 13; Plate 4, fig. 43.

Size large; general coloration yellow, the præscutum with three black stripes, the lateral pair straight or with an isolated brown spot opposite their anterior end; antennal flagellum black, the segments rather strongly incised; occipital brand small; pronotum, scutellum, and mediotergite yellow; pleura yellow, variegated by more reddish areas; fore femora broadly blackened, the remaining femora narrowly so; wings yellow, more saturated in costal portion; stigma dark brown, with few trichia; narrow dark seams on cord and at wing tip; abdomen yellow, indistinctly trivittate with darker; subterminal segments black; hypopygium pale at apex; lateral horns of ninth tergite of male hypopygium slender, glabrous; eighth sternite unarmed; gonapophyses appearing as flattened blades.

*Male.*—Length, 15 to 16 millimeters; wing, 14 to 15.

*Female.*—Length, 22 to 23 millimeters; wing, 15 to 16.

Frontal prolongation of head obscure yellow, darker dorsally, the nasus black; palpi brown. Antennæ with scape and pedicel orange; flagellum black; flagellar segments rather strongly incised; verticils a little shorter than the segments. Head orange; occipital brand small, dark brown, triangular in outline; vertical tubercle entire; a small brown orbital spot on either side of vertical tubercle.

Pronotum and propleura entirely yellow. Mesonotal præscutum yellow, with three black stripes that are very insensibly margined with more opaque black; lateral stripes straight or with a small isolated paler brown spot opposite their anterior ends; scutum yellow, each lobe with two confluent black areas, crossing the suture and becoming confluent with the lateral præscutal stripes; scutellum testaceous-yellow, the parascutella bright yellow; mediotergite yellow, the posterior portion slightly more orange though scarcely darkened; the type female shows a median linear dark dash on mediotergite. Pleura yellow, variegated by more reddish areas on ventral anepisternum, ventral sternopleurite, ventral meron and ventral pleurotergite. Halteres yellow, the base of knob weakly darkened, the apex clear light yellow. Legs with the coxæ and trochanters yellow; femora yellow, the tips blackened, very broadly so on the forelegs where more than the outer half is included; narrower on the middle and posterior legs where only the outer eighth or tenth is darkened; tibiæ obscure yellow, the tips narrowly darkened; tarsi black. Wings (Plate 1, fig. 13) with a yellow tinge, the base and cells C and Sc clearer yellow; stigma oval, dark brown; wing tip narrowly infumed; cord, including the distal section of vein $Cu_1$, seamed with brown; veins beyond cord more narrowly seamed with darker; veins dark brown, the prearcular and costal veins more yellow. Stigmal trichia reduced in number to five or six. Venation: $Sc_2$ ending opposite or just beyond origin of Rs, $Sc_1$ barely indicated; cell $M_1$ sessile; m-cu just beyond origin of vein $M_4$.

Abdomen obscure yellow, the basal segments scarcely marked or with vague indications of darker stripes only; in female, with three darker stripes; male with subterminal segments intensely black, the styli yellow; basal sternites unmarked. Male hypopygium with the ninth tergite (Plate 4, fig. 43, *9t*) having the lateral horns slender and entirely glabrous; intermediate lobes obtuse, with numerous black spines and setæ, the apex further produced into a triangular pale point. Outer dististyle, *od,* pale, only moderately attenuated at tip, the cephalic margin a little attenuate. Inner dististyle, *id,* without dorsal crest. Eighth sternite with the caudal margin virtually entire or with a barely indicated median emargination, without lobes; setæ of posterior border longer but not modified into brushes. Gonapophyses, *g,* elongate, compressed-flattened, in profile appearing like a duck's head, the tip obtuse.

*Habitat.*—Eastern Siberia, Manchoukuo.

Holotype, male, Silinche Station, East Chinese Railway, Manchoukuo, July 10, 1911 (*Spechilov*). Allotype, female, Ulunga, Amur Province, eastern Siberia, June 24, 1910 (*Mishin*). Paratypes, a broken female, Habarovsk district, Samnjur River, Amur Province, July 9 to 11, 1910 (*Czerski*); a broken male, Bikin River, Ussuri, July 9, 1927 (*Martynov*); a broken male, Maiche region, near Shkotovo, June 4, 1927 (*Martynov*).

The species is named in honor of Dr. A. B. Martynov, distinguished student of recent and fossil insects. The nearest relatives are species such as *Nephrotoma geminata* Alexander and *N. subpallida* Alexander, which are readily told by the small size, different coloration of the wings, and the structure of the male hypopygium. The unmarked prothorax and mediotergite separate the species from other large, somewhat similar species in the western Palæarctic region, such as *N. quadrifaria* (Meigen).

**NEPHROTOMA DAISENSIS** sp. nov. Plate 1, fig. 14.

General coloration yellow and black; antennæ black throughout; mesonotal præscutum almost entirely covered by a black dorsal shield composed of the entirely confluent stripes; scutellum and parascutella black; mediotergite black; pleura yellow, conspicuously variegated by black areas; femora yellow basally, the tips broadly blackened; wings with a strong yellow tinge; stigma long-oval, dark brown; wing tip broadly infumed; $Sc_2$ ending some distance beyond the origin of Rs, $Sc_1$ lacking; abdominal tergites orange, the outer segments uniformly blackened, the intermediate tergites with black triangular areas.

*Female.*—Length, about 16 millimeters; wing, 14.5.

Frontal prolongation of head polished black above, more yellow on sides; nasus black; palpi obscure brownish yellow. Antennæ black throughout; flagellar segments (female) with basal enlargements poorly developed; verticils longer than the segments. Head sulphur yellow, the occiput and posterior vertex velvety black, the color extending cephalad to the level of the narrowest part of the anterior vertex and here sending a broad orbital extension to the eyes; ground color restricted to the front, anterior part of vertex and posterior orbits; genæ more pruinose, with long silvery setæ.

Pronotum broadly yellow medially, the sides conspicuously blackened. Mesonotal præscutum almost covered by a large shield-shaped polished black area comprising the usual three stripes that are entirely confluent; yellow ground color restricted to humeral triangles and a smaller linear area before the suture; darkened shield not or scarcely bordered by more opaque black; scutum with lobes black, the obscure yellow ground restricted to the anterior half of the median area and small, brighter yellow, lateral areas above the wing root; scutellum and parascutella black, the surface very weakly pruinose; mediotergite black, very weakly pruinose, brightened by yellow only at extreme anterolateral angle. Pleura yellow, conspicuously variegated by black on the propleura, anepisternum, ventral sternopleurite, ventral meron, ventral pteropleurite, and as a large U-shaped area on the pleurotergite. Halteres obscure yellow throughout. Legs with the coxæ gray pruinose, with conspicuous white setæ, the apices of posterior coxæ obscure yellow; trochanters yellow; femora yellow basally, the tips broadly blackened, more conspicuously so on the forelegs where more than the outer half is included, narrowest on the posterior legs where about the distal fourth is darkened; tibiæ brown, the tips darker; tarsi black. Wings (Plate 1, fig. 14) with a strong yellow tinge, prearcular region and cells C and Sc more saturated yellow; stigma long-oval, dark brown; wing tip broadly infumed; a diffuse brown seam along cord, reaching the posterior margin along distal section of vein $Cu_1$; veins dark brown, more yellow in the brightened areas. About twenty-five stigmal trichia in cell $R_1$. Venation: $Sc_2$ ending some distance beyond origin of the straight Rs, $Sc_1$ lacking; cell $M_1$ petiolate; m-cu on $M_4$ some distance beyond origin.

Abdominal tergites with the ground color orange; basal tergite black, more grayish laterally; tergites two to four black medially, the areas triangular, with the point directed cephalad; succeeding tergites blackened, only the base of the fifth restrictedly pale.

*Habitat.*—Japan (Honshiu).

Holotype, female, Mount Daisen, Hôki, altitude 2,600 feet, June 6, 1930 (*Hibi*).

The nearest allies appear to be *Nephrotoma ozenumensis* Alexander and *N. pullata* (Alexander), which differ in the details of coloration. The present fly has the entire disk of the præscutum polished black, without indications of different color on the interspaces; the scutellum, parascutella, and mediotergite conspicuously black.

**NEPHROTOMA CATENATA** sp. nov. Plate 1, fig. 15.

General coloration of mesonotal præscutum yellow, with three polished black stripes that are bordered by velvety black, more broadly so at and near their cephalic ends so all three stripes are interconnected; scutellum, parascutella, mediotergite, and pleura yellow; halteres dusky; wings broad, pale grayish yellow, stigma yellow; abdomen yellow to weakly brownish yellow, unpatterned except for darkenings on tergites six and seven.

*Female.*—Length, 15 to 16 millimeters; wing, 12 to 12.5.

Frontal prolongation of head light yellow, a little deeper yellow above and on nasus, the latter with black setæ; palpi yellow, the basal two segments weakly darker. Antennæ with basal five segments yellow, the succeeding segments passing into dark brown; flagellar segments (female) scarcely incised; longest verticils subequal to or a little longer than the segments. Head orange-yellow; no occipital brand.

Pronotum clear light yellow above, more reddish yellow on sides. Mesonotal præscutum light yellow, with three polished black stripes that are narrowly bordered by velvety black; extensive invasions of this latter color include the sides of the sclerite, involving the entire lateral border excepting a small yellow spot at midlength of the lateral stripe; the lateral and median stripes broadly connected at cephalic ends of former, restricting the yellow ground color to the posterior interspaces; entire cephalic border of median stripe velvety black; scutum with lobes polished black, the suture and lateral portions velvety black, connecting with the lateral præscutal areas, restricting the yellow ground color to a narrow median area; scutellum, including parascutella, yellow, mediotergite entirely yellow. Pleurotergite and pleura yellow, the latter slightly variegated with reddish yellow on anepisternum and ventral sternopleurite. Halteres dusky, the base of stem restrictedly pale. Legs with the coxæ and trochanters yellow; remainder of legs obscure yellow, the tips of femora and tibiæ very narrowly and weakly darkened; terminal tarsal segments brownish black. Wings (Plate 1, fig. 15) broad, pale grayish yellow, the prearcular region and cells C and Sc clearer yellow; stigma yellow; veins brown. A few stigmal trichia in cell $R_1$. Venation: $Sc_2$ ending a short distance beyond origin of the oblique Rs, $Sc_1$ represented by a weak spur; cell $M_1$ narrowly sessile; m-cu a short distance before fork of $M_4$, the latter a corresponding distance before fork of $M_3$.

Abdomen yellow to weakly brownish yellow on tergites, but without evident pattern; sixth and seventh tergites more darkened.

*Habitat.*—China (Szechwan).

Holotype, female, Mount Omei, altitude 11,000 feet, August 18, 1934 (*Graham*). Paratopotype, female.

*Nephrotoma catenata* is very distinct from the other regional species of the genus in the peculiar pattern of the præscutum and scutum. I cannot indicate any close allies, but the species shows some points of resemblance to *N. minuticornis* Alexander (Japan).

**NEPHROTOMA ATROSTYLA** sp. nov. Plate 1, fig. 16; Plate 4, fig. 44.

**Mesonotal præscutum yellow with three polished black stripes; lateral stripes outcurved but entirely polished; antennæ with basal three segments yellow, the succeeding flagellar segments dark brown, with their bases yellow; occipital brand very extensive; central portion of mediotergite darkened; pleura almost uniformly yellow; wings tinged with yellow; stigma rather dark brown; wing tip and a seam on anterior cord brown; abdominal tergites trivittate with black; male hypopygium with both dististyles black; outer style sole-shaped.**

*Male.*—Length, about 11 millimeters; wing, 10.5.

Frontal prolongation of head short, yellow, the nasus a little darker; palpi brown. Antennæ with basal three segments yellow; succeeding flagellar segments bicolorous, dark brown, with the basal enlargements conspicuously yellow; at midlength of the organ, the yellow color becomes more obscure and finally passes into brown; longest verticils nearly as long as the slender segments. Head orange, the extensive occipital and posterior portions of the vertex brown, triangular in outline, the point at anterior end disconnected from a delicate brown median line on vertical tubercle.

Pronotum yellow, weakly darkened on sides. Mesonotal præscutum yellow, with three polished black stripes, the median one very broad in front; lateral stripes strongly outcurved almost to margin, the outcurved portion equally polished; median area of scutum yellow, the lobes covered by extensive polished black areas; lateral ends of suture black; scutellum brownish testaceous, the parascutella a trifle darker; mediotergite yellow with a broad, dark brown, median stripe on anterior half, the posterior portion more extensively paler brown; mediotergite with setæ on posterolateral portions. Pleura polished yellow, scarcely variegated by more reddish areas, these most evident on ventral portion of pleurotergite. Halteres chiefly pale brown, the apices of knobs a trifle brightened. Legs with coxæ and trochanters yellow; remainder of legs broken. Wings (Plate 1, fig. 16) tinged with yellow, the costal region scarcely brighter; stigma oval, rather dark brown; wing tip narrowly but conspicuously dark brown; a conspicuous brown cloud on anterior cord; posterior cord more narrowly seamed; veins brown. About a score of stigmal trichia in cell $R_1$. Venation: $Sc_2$ ending a short distance beyond origin of Rs; r-m reduced by approximation of veins; cell $M_1$ broadly sessile; cell 1st $M_2$ elongate, parallel-sided; m-cu at fork of $M_{3+4}$; cell $M_4$ narrow.

Abdomen orange, the tergites extensively blackened medially, the basal ring undarkened; lateral borders of tergites conspicuously blackened on outer ring; eighth and ninth segments, including style of hypopygium, chiefly black; basal sternites yellow, the intermediate segments black. Male hypopygium with the tergite (Plate 4, fig. 44, 9*t*) having two broadly flattened, divergent lobes, separated by a U-shaped notch, the blackened spines numerous; dorsal surface of tergite highly protuberant on either side of a narrow median depression. Outer dististyle, *od,* sole-shaped; marginal setæ short, basal ones long and stout. Inner dististyle, *id,* with the apical beak slender; no dorsal crest. Eighth sternite with caudal margin entire; from membrane between the eighth and ninth sternites a depressed rectangular lobe, more or less parallel-sided, the tip obtuse. Gonapophyses exceeding the very small ædeagus, each apophysis unequally bifid at apex (Plate 4, fig. 44, *p*).

*Habitat.*—Eastern Siberia.

Holotype, male, Samnjur River, near Habarovsk, Ussuri, July 7, 1910 (*Gondatti Expedition*); Russian Academy of Sciences.

The bicolorous flagellar segments, with the bases yellow, together with the black hypopygium, readily separate the present fly from other regional species. By manuscript keys, it runs to *Nephrotoma angustistria* Alexander, of northern Japan, differing most evidently in all details of structure and coloration of the male hypopygium. The antennæ of the male sex are much shorter than in *angustistria*.

## LIMONIINÆ

### LIMONIINI

**LIMONIA (LIBNOTES) PERPARVULOIDES sp. nov. Plate 1, fig. 17; Plate 4, fig. 45.**

Allied to *perparvula;* tips of femora narrowly and abruptly yellow; wings pale grayish subhyaline; stigma oval, pale brown; $Sc_1$ ending just beyond fork of Rs, $Sc_2$ at its tip; Rs relatively long and oblique, approximately three times as long as the basal section of $R_{4+5}$.

*Male.*—Length, about 4.5 millimeters; wing, 5.

Head broken.

Mesonotal præscutum yellow, darkened medially and less distinctly on the sides; posterior sclerites of notum testaceous-yellow, the scutal lobes weakly darkened. Pleura with the anepisternum and sternopleurite weakly darkened, the posterior sclerites and pleurotergite more testaceous-yellow. Halteres pale, the knobs dark brown. Legs with the coxæ and trocanters testaceous-yellow; femora brownish black, the tips narrowly and abruptly light yellow; tibiæ black, the tarsi a very little paler. Wings (Plate 1, fig. 17) pale grayish subhyaline, the prearcular region and cells C and Sc pale yellow; stigma oval, pale brown; veins brown, more flavous in the yellow areas. Venation: Sc of moderate length, $Sc_1$ ending just beyond fork of Rs, $Sc_2$ at its tip; Rs relatively long and oblique, much longer than in *perparvula,* approximately three times the basal section of $R_{4+5}$; free tip of $Sc_2$ and $R_2$ in transverse alignment; m-cu at midlength of the long cell 1st $M_2$; anal veins beyond origin gently convergent.

Abdominal tergites brown, the lateral margins darker; sternites more yellow. Male hypopygium (Plate 4, fig. 45) much as in *perparvula* but the apex of the rostral prolongation of the ventral dististyle, *vd,* a little stouter. In both species, the surface of the dorsal dististyle has several very delicate setulæ.

*Habitat.*—Formosa.

Holotype, male, Raisya, altitude 2,500 feet, November 21, 1934 (*Issiki*).

Very closely allied to and possibly only a geographical race of *Limonia* (*Libnotes*) *perparvula* Alexander (Luzon), which differs chiefly in the venation of the radial field. The latter species is now known from two provinces in Luzon (Pampanga and Tayabas) and shows very little variation in the venation of the radial field. These two species are the smallest representatives of the subgenus so far discovered in the Philippines and northward in eastern Asia.

**LIMONIA (LIMONIA) EDURA sp. nov.** Plate 1, fig. 18.

General coloration reddish brown, the disk of præscutum with indications of three darker stripes; front silvery white; anterior vertex wide; halteres and legs dark; wings with a strong fulvous-brown tinge, with narrow, darker brown seams on the cross-veins and deflections; Rs very long, in alignment with $R_{2+3}$; cell 1st $M_2$ elongate, subequal to vein $M_{1+2}$ beyond it; m-cu shortly before fork of M.

*Female.*—Length, about 6 millimeters; wing, 6.5.

Rostrum and palpi black. Antennæ with scape and pedicel black; flagellum broken. Front and anterior portion of vertex silvery white; posterior portion of vertex black; anterior vertex wide, the eyes with coarse ommatidia.

Pronotum obscure yellow. Mesonotal præscutum reddish brown, the humeral and lateral portions paling to yellow, the disk with very vague indications of three darker stripes; posterior sclerites of notum dark brown. Pleura dark brown. Halteres relatively short, dusky. Legs with the fore coxæ dark brown, the remaining coxæ and all trochanters more brownish yellow; remainder of legs dark brown. Wings (Plate 1, fig. 18) with a strong fulvous-brown tinge, the prearcular field light yellow; very narrow, darker brown seams at fork of Sc, origin of Rs, stigma, cord, and outer end of cell 1st $M_2$, best indicated by the darker veins; veins pale, except as noted above. Venation: Sc relatively long, $Sc_1$ ending beyond one-third the length of Rs, $Sc_2$ at its tip; Rs very long, in alignment with $R_{2+3}$; free tip of $Sc_2$ pale, lying shortly basad of the gently arcuated $R_2$; cell 1st $M_2$ elongate, subequal to vein $M_{1+2}$ beyond it; m-cu shortly before fork of M, about two-thirds the distal section of $Cu_1$; anal veins at bases gently diverging.

Abdomen dark brown, the segment before the hypovalvæ pale. Ovipositor with cerci very small, slender and upcurved, the much larger, compressed hypovalvæ blackened at bases.

*Habitat.*—Japan (Honshiu).

Holotype, female, Yumoto, Shimotsuke, altitude 5,000 feet, August 7, 1934 (*Issiki*).

*Limonia* (*Limonia*) *edura* is very different from other small regional species of the subgenus. It is somewhat like *L.* (*L.*)

*yakushimensis* Alexander, but the alliance is not particularly close and I cannot indicate any other similar species.

**LIMONIA (LIMONIA) JUVENCA** sp. nov. Plate 1, fig. 19; Plate 4, fig. 46.

General coloration of mesonotum light yellow, the præscutum with a median brown stripe that is constricted at midlength; antennæ (male) relatively elongate; pleura yellow; halteres dusky; legs brown, the femora without paler annuli; wings pale brown, variegated by darker clouds and pale areas; Sc unusually short, $Sc_2$ ending exactly opposite the origin of Rs, $Sc_1$ at its tip; m-cu before fork of M; male hypopygium with a single dististyle that terminates in a pendant blackened lobe; ædeagus with the surface covered by dense pale setulæ.

*Male.*—Length, about 6.5 millimeters; wing, 6.5.

Rostrum and palpi black, the former moderately elongate, approximately one-third to one-fourth the remainder of head. Antennæ brown, the scape a little darker; antennæ elongate, if bent backward extending to the wing root or approximately so; flagellar segments subcylindrical to long-oval, with a dense white pubescence, additional to the short verticils. Head dark grayish brown.

Pronotum and cervical sclerites dark brown, paler laterally. Mesonotal præscutum light yellow, with a conspicuous, bright brown, median stripe that is somewhat constricted at midlength; scutal lobes darkened, the median area pale; scutellum yellow, the parascutella darker; mediotergite brownish testaceous. Pleura yellow. Halteres dusky, the base of stem restrictedly yellow. Legs with the coxæ and trochanters yellow, femora uniformly brown, without sign of apical or subapical brightening; tibiæ and tarsi brown. Wings (Plate 1, fig. 19) slightly teneral, pale brown, variegated by slightly darker clouds and paler areas; the darker clouds include the origin of Rs, cord, outer end of cell 1st $M_2$, wing tip, and an area in cell R at near midlength; stigma darker brown; veins brown. Venation: Sc very short, $Sc_2$ ending exactly opposite origin of Rs, $Sc_1$ shortly before its tip; $R_{1+2}$ about twice $R_2$; m-cu a short distance before fork of M.

Abdomen dark brown; hypopygium scarcely brighter. Male hypopygium (Plate 4, fig. 46) with the caudal margin of tergite, *9t*, gently emarginate, with conspicuous setæ. Basistyle, *b*, with ventromesal lobe very extensive, appearing as a densely setiferous cushion. Dististyle, *d*, with abundant setæ, the pendant tip constricted and blackened. Gonapophyses, *g*, with mesal-apical lobe long and slender, the extreme tip narrowed and blackened. Ædeagus, *a*, depressed, the entire surface with abundant delicate pale setulæ, the apex with two divergent arms.

*Habitat.*—Japan (Honshiu).

Holotype, male, Yumoto, Shimotsuke, altitude 5,000 feet, August 5, 1934 (*Issiki*).

The nearest ally of the present species is *Limonia* (*Limonia*) *esakii* (Alexander), of Formosa. It is even closer to specimens from Honshiu that I had formerly considered to represent *esakii*, but which I am now compelled to regard as being at least subspecifically distinct. The present fly differs from the latter specimens in the unvariegated femora and the unusually short Sc. The latter feature is quite as in the subgenus *Dicranomyia*, but the structure of the male hypopygium is definitely as in *Limonia*.

### LIMONIA (LIMONIA) NITOBEI (Edwards).

*Limnobia nitobei* EDWARDS, Ann. & Mag. Nat. Hist. VIII 18 (1916) 247–248.

Hitherto known only from the unique type male, taken on Arisan, Formosa, altitude 8,000 feet, October 10, 1912, by Nitobe.

Allotype, female, Raisya, Formosa, altitude 3,000 feet, November 24, 1934 (*Issiki*).

*Female.*—Length, about 8 millimeters; wing, 9.

Differs from the male, as described, only as follows:

Antennæ black throughout. Anterior vertex about as wide as diameter of scape. Mesonotal præscutum with a brown median stripe, additional to the darker lateral stripes. Pleura chiefly intense black, the color involving the ventral anepisternum and all of the sternopleurite, pteropleurite, and pleurotergite, the dorsal anepisternum and dorsopleural region almost entirely yellow. Fore and middle coxæ extensively blackened on outer faces; basal dark ring of femora very narrow and much paler than the black tip. Wings with inner ends of cells 2d $M_2$ and $M_3$ (closing cell 1st $M_2$) about in transverse alignment or with the latter a little closer to the wing base. Dark abdominal rings black or nearly so, involving not only the broad bases but also the adjoining very narrow posterior borders and extreme lateral margins.

### LIMONIA (PSEUDOGLOCHINA) MONOCYCLA sp. nov. Plate 1, fig. 20.

Mesonotum brown, the præscutum darker on borders; median region of posterior sclerites of notum pale; flagellar segments with the secondary pubescence much shorter than the verticils;

tibiæ white, each with a single narrow dark ring; wings faintly tinged with brownish yellow; stigma oval, dark brown; Sc long, $Sc_1$ ending opposite r-m or virtually so; m-cu shortly beyond fork of M; cell 2d $M_2$ deep; cell 2d A small.

*Male*.—Length, about 6 to 7 millimeters; wing, 6.5 to 8.

Rostrum brown; palpi black. Antennæ with the scape dark brown, the remainder of organ black; flagellar segments oval, with short but conspicuous apical pedicels to produce a bead-like appearance; longest verticils subequal in length to the segments; secondary pubescence short and inconspicuous; terminal segment longer than the penultimate, the outer end narrowed. Head light fulvous.

Pronotum slightly darkened medially, the sides whitish. Mesonotal præscutum brown medially, bordered laterally by darker brown; scutum dark brown, slightly paler medially; scutellum pale brown, the parascutella darker; mediotergite paler medially than at the sides. Pleura chiefly pale yellow, the ventral sternopleurite dark brown. Halteres dark brown throughout. Legs with the coxæ dark brown, the fore coxæ paler basally; trochanters black; fore femora white, the extreme base and wider apex black; middle femora dusky on basal third, thence paling to dirty white, the tip narrowly black, preceded by a subequal clearer white ring; posterior femora broadly black at both ends, the intermediate half or more only a little paler, brownish black; all tibiæ white, with a narrow black ring just before midlength; tarsi white. Wings (Plate 1, fig. 20) faintly tinged with brownish yellow, cells C and Sc slightly more saturated yellow; stigma oval, dark brown, very conspicuous; veins beyond cord brownish black, basad of cord somewhat paler. Venation: Sc long, $Sc_1$ ending opposite r-m or virtually so, $Sc_2$ about opposite fork of Rs; in the paratype figured, Sc is a little shorter; m-cu shortly beyond fork of M; cell 2d $M_2$ deep, approximately three times its petiole; cell 2d A small but extended, the anal angle weak.

Abdominal tergites chiefly dark brown, the caudal margins restrictedly paler; sternites paler brown, the caudal borders more broadly yellow; hypopygium chiefly pale, the ventral dististyle yellow.

*Habitat*.—Formosa.

Holotype, male, Kanshirei, altitude 1,500 feet, October 17, 1934 (*Issiki*).

The nearest allies are *Limonia* (*Pseudoglochina*) *angustapicalis* Alexander (Luzon), which differs in the coloration, venation, and structure of the antennæ, which are longer, with the secondary pubescence of the flagellar segments long and conspicuous; and *L.* (*P.*) *unicinctipes* Alexander (Philippines and Borneo), which differs in the wing coloration and venation, as the short Sc, with $Sc_1$ ending before the fork of Rs.

**LIMONIA (PSEUDOGLOCHINA) DIMELANIA** sp. nov. Plate 1, fig. 21.

Mesonotal præscutum brown, the anterolateral and cephalic portions white; posterior sclerites of mesonotum dark brown, with a narrow white median line; tibiæ with two narrow black rings; wings strongly suffused with brown, cells C and Sc darker; stigma long-oval, dark brown; $Sc_1$ ending about opposite midlength of the long Rs, the latter nearly twice the basal section of $R_{4+5}$; cell 2d $M_2$ a little longer than its petiole; m-cu at fork of M; vein 2d A long.

*Male.*—Length, about 6 millimeters; wing, 6.8.

Rostrum dark brown; palpi black. Antennæ relatively short, black throughout; verticils shorter than the oval segments, the latter with short apical pedicels; secondary pubescence relatively long, only a little shorter than the verticils; terminal segment equal in length to the penultimate. Head orange-fulvous.

Pronotum entirely white. Mesonotal præscutum very convex and protuberant, the anterolateral and cephalic portions white, only weakly darkened medially; remainder of mesonotum rather dark brown, with a narrow white median line, beginning beyond midlength of the præscutum, extending caudad to base of abdomen, narrowly bordered throughout its length by more brownish black. Pleura white, the ventral sternopleurite brownish black. Halteres dark throughout. Legs with the fore coxæ and trochanters dark, the remaining coxæ and trochanters pale; middle leg with femora yellow, paling to white on distal third, the tip narrowly and weakly darkened; posterior femora yellow, the posterior fourth or fifth black, the extreme tip pale; forelegs broken; tibiæ white, each with two narrow black rings, the first at near one-fourth the length, the second just beyond midlength; tarsi white. Wings (Plate 1, fig. 21) strongly suffused with brown, cells C and Sc even darker; stigma long-oval, dark brown; a small dark cloud at origin of Rs; veins brown. A few scattered trichia at distal end of vein 1st A; trichia shorter than in *riukiuensis*. Venation: $Sc_1$ ending opposite or just beyond midlength of the long Rs, $Sc_2$ immediately beyond the origin of the latter; Rs nearly two times the basal section of $R_{4+5}$; cell 2d $M_2$ a little longer than its petiole; m-cu at fork of M; vein 2d A long, but still shorter than in *riukiuensis*.

Abdomen with the tergites dark brown, the central portions and posterior margins of the intermediate segments a little paler; sternites pale; hypopygium dark.

*Habitat.*—Formosa.

Holotype, male, Kanshirei, altitude 1,500 feet, October 17, 1934 (*Issiki*).

The nearest ally is *Limonia* (*Pseudoglochina*) *riukiuensis* Alexander, which differs most conspicuously in the pattern and venation of the wings.

### ANTOCHA (ANTOCHA) PLATYPHALLUS sp. nov. Plate 1, fig. 22; Plate 4, fig. 47.

General coloration of mesonotal præscutum light brown; antennæ short, black throughout; halteres pale throughout; wings with a gray tinge, the veins very pale and scarcely apparent; abdomen dark brown, the hypopygium paler; male hypopygium with the dististyles fused basally; ædeagus and subtending apophyses forming a flattened, depressed phallosome.

*Male.*—Length, about 5.5 millimeters; wing, 6.5.

Rostrum brown; palpi black. Antennæ short, black throughout; flagellar segments oval; terminal segment about one-third longer than the penultimate; verticils a little shorter than the segments. Head brownish gray.

Pronotum dark brown. Mesonotal præscutum with the ground color gray, the disk chiefly covered by three light brown stripes, the median one a little more intensely darkened on cephalic portion; posterior sclerites of notum testaceous-yellow. Pleura testaceous-yellow, weakly infumed on ventral sternopleurite. Halteres pale throughout. Legs with the coxæ and trochanters yellow; remainder of legs pale brown. Wings (Plate 1, fig. 22) with a gray tinge, the prearcular region whitish; veins so pale as to be but little evident against the ground. Venation: $R_2$ lying a little distad of level of r-m; m-cu shortly before fork of M.

Abdomen dark brown; hypopygium brownish yellow. Male hypopygium (Plate 4, fig. 47) with the dististyles more or less fused on basal fourth, almost superimposed in a position of rest; inner style a little dilated near base. Ædeagus unusually broad, depressed, the apex trilobed, the organ subtended by gonapophyses with acute, mesally directed tips. Inner gonapophyses, *g*, with a short branch, the apex obtusely rounded.

*Habitat.*—Japan (Honshiu).

Holotype, male, Yumoto, Shimotsuke, altitude 5,000 feet, August, 5, 1934 (*Issiki*).

The coloration of the wings, with pale veins, is much like that of *Antocha* (*Antocha*) *sagana* Alexander, but the structure of the male hypopygium is quite different from that of any regional species so far described.

### ERIOPTERINI

**GONOMYIA (GONOMYIA) LATIFOLIA sp. nov.** Plate 1, fig. 23; Plate 4, fig. 48.

Allied to *foliacea;* rostrum orange-yellow; mesonotal præscutum and scutum dark brown, sparsely pruinose; scutellum clear yellow; pleura pale brown, striped longitudinally with whitish; knobs of halteres weakly darkened; legs brownish black; wings grayish subhyaline, the stigma pale brown; Sc long, $Sc_1$ ending at about midlength of Rs; m-cu about one-half its length beyond fork of M; abdominal tergites dark brown; male hypopygium with the outer dististyle a flattened, foliaceous blade, the surface sparsely setiferous; inner dististyle with the apical spine acute at tip; ædeagus complex, the ventral margin with several pale spinous points.

*Male.*—Length, about 4.5 millimeters; wing, 4.8.

Rostrum orange-yellow; palpi dark. Antennæ black throughout. Head gray.

Mesonotal præscutum and scutum dark brown, sparsely pruinose, the humeral region of the former restrictedly brightened; pseudosutural foveæ dark; extreme posterior margin of scutal lobes and anterior half of median area yellow, the posterior half of latter black and heavily pruinose; scutellum clear light yellow, the parascutella dark; mediotergite black, heavily pruinose. Pleura pale brown, striped longitudinally with whitish, the latter including the dorsopleural region and a ventral stripe from behind the fore coxæ to the base of abdomen. Halteres of moderate length only, pale, the knobs weakly darkened. Legs with the coxæ and trochanters brown; remainder of legs brownish black. Wings (Plate 1, fig. 23) grayish subhyaline, the prearcular region narrowly yellowish; stigma pale brown, ill-delimited; veins brownish black. Costal fringe of moderate length. Venation: $Sc_1$ ending almost opposite midlength of Rs, $Sc_2$ close to its tip; m-cu about one-half its length beyond fork of M.

Abdominal tergites dark brown, the outer sternites somewhat paler. Male hypopygium (Plate 4, fig. 48) with the outer dististyle, *od,* a flattened foliaceous blade, much as in *foliacea,* the tip exceedingly acute; surface of style with setæ small and reduced in number, the mesal edge quite glabrous. Inner dististyle, *id,* almost as long, complex in structure, as shown by the figure; outer arm blackened and acute at tip, nearer base with two spinous points and a powerful black spinous seta; inner lobe with two fasciculate bristles. Gonapophyses, *g,* blackened, the two together appearing more or less lyriform, the outer margin of each with a small acute spine, much as in *bibarbata.* Ædeagus, *a,* complex, the ventral margin with several pale spinous points that are not present in *foliacea.*

*Habitat.*—Formosa.

Holotype, male, Kanshirei, altitude 1,500 feet, October 19, 1934 (*Issiki*).

The nearest relative is *Gonomyia* (*Gonomyia*) *foliacea* Alexander (Formosa), which differs in the coloration of the thorax and legs and in the structure of the male hypopygium, especially the inner dististyle and ædeagus.

GONOMYIA (LIPOPHLEPS) PRÆDITA sp. nov. Plate 1, fig. 24.

Belongs to the *abbreviata* group; most nearly allied to *gracilistylus;* wings gray, without brown tinge, narrow, the anal cells correspondingly restricted; vein $R_3$ with macrotrichia throughout its length.

*Female.*—Length, about 4.5 millimeters; wing, 4.8.

Rostrum brown; palpi black. Antennæ dark throughout; flagellar segments elongate, the verticils relatively long and conspicuous (for the female sex). Head dark.

Pronotum yellow. Mesonotal præscutum pale brown, sparsely pruinose, the humeral region yellow; pseudosutural foveæ pale; posterior sclerites of notum paler, the scutellum yellow, dusted with whitish pollen. Pleura chiefly pale, the anepisternum somewhat darkened. Halteres moderately elongate, the stem pale, the knob weakly darkened. Wings (Plate 1, fig. 24) tinged with gray, the stigmal region undarkened; veins pale brown; wings much narrower than in *gracilistylus,* the cells correspondingly narrowed, most evident in the anal field. Vein $R_3$ with macrotrichia throughout its entire length. Venation: Rs angulated and spurred at origin; distance on costa between tips of veins $R_{1+2}$ and $R_3$ about equal in length to the latter vein.

Abdominal tergites brown, the sternites more yellowish. Ovipositor with the valves long and slender, especially the cerci.

*Habitat.*—Formosa.

Holotype, female, Kanshirei, altitude 1,500 feet, October 17, 1934 (*Issiki*).

The nearest relative of the present fly is *Gonomyia* (*Lipophleps*) *gracilistylus* Alexander (Japan: Honshiu, Kiushiu), which differs in the broad, strongly tinted wings and details of trichiation. The male sex in this group of species offers unusually strong characters, and it may be expected that additional structures will be available when the male of the present insect is discovered. I formerly placed the members of this group in the subgenus *Gonomyia,* but now follow Edwards[7] in considering the *abbreviata* group as being more correctly placed in *Lipophleps*.

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[7] Journ. Fed. Malay St. Mus. 14 (1928) 103.

# ILLUSTRATIONS

[*a*, Ædeagus; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

## PLATE 1

FIG. 1. *Ctenacroscelis ignicaudatus* sp. nov., venation.
2. *Ctenacroscelis quadrifasciculatus* sp. nov., venation.
3. *Tipula (Arctotipula) miyadii* sp. nov., venation.
4. *Tipula (Schummelia) stipata* sp. nov., venation.
5. *Tipula (Lunatipula) justa* sp. nov., venation.
6. *Nephrotoma integra* sp. nov., venation.
7. *Nephrotoma esakii* Alexander, venation.
8. *Nephrotoma serristyla* sp. nov., venation.
9. *Nephrotoma profunda* sp. nov., venation.
10. *Nephrotoma bifascigera* sp. nov., venation.
11. *Nephrotoma sublamellata* sp. nov., venation.
12. *Nephrotoma chosensis* sp. nov., venation.
13. *Nephrotoma martynovi* sp. nov., venation.
14. *Nephrotoma daisensis* sp. nov., venation.
15. *Nephrotoma catenata* sp. nov., venation.
16. *Nephrotoma atrostyla* sp. nov., venation.
17. *Limonia (Libnotes) perparvuloides* sp. nov., venation.
18. *Limonia (Limonia) edura* sp. nov., venation.
19. *Limonia (Limonia) juvenca* sp. nov., venation.
20. *Limonia (Pseudoglochina) monocycla* sp. nov., venation.
21. *Limonia (Pseudoglochina) dimelania* sp. nov., venation.
22. *Antocha (Antocha) platyphallus* sp. nov., venation.
23. *Gonomyia (Gonomyia) latifolia* sp. nov., venation.
24. *Gonomyia (Lipophleps) prædita* sp. nov., venation.

## PLATE 2

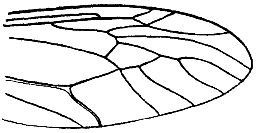
FIG. 25. *Ctenacroscelis ignicaudatus* sp. nov., five basal segments of antennal flagellum, male.
26. *Ctenacroscelis ignicaudatus* sp. nov., male hypopygium, details.
27. *Ctenacroscelis ignicaudatus* sp. nov., male hypopygium, details.
28. *Ctenacroscelis libertus* sp. nov., male hypopygium, details.
29. *Ctenacroscelis quadrifasciculatus* sp. nov., five basal segments of antennal flagellum, male.
30. *Ctenacroscelis quadrifasciculatus* sp. nov., male hypopygium, details.
31. *Ctenacroscelis regius* sp. nov., five basal segments of antennal flagellum, female.
32. *Tipula (Arctotipula) miyadii* sp. nov., male hypopygium, details.
33. *Tipula (Schummelia) stipata* sp. nov., male hypopygium, details.
34. *Tipula (Lunatipula) justa* sp. nov., male hypopygium, details.

## PLATE 3

FIG. 35. *Nephrotoma integra* sp. nov., male hypopygium, details.
36. *Nephrotoma esakii* Alexander, male hypopygium, details.
37. *Nephrotoma serristyla* sp. nov., male hypopygium, details.
38. *Nephrotoma profunda* sp. nov., male hypopygium, details.
39. *Nephrotoma bifascigera* sp. nov., male hypopygium, details.
40. *Nephrotoma bifascigera* sp. nov., male hypopygium, details.

## PLATE 4

FIG. 41. *Nephrotoma sublamellata* sp. nov., male hypopygium, details.
42. *Nephrotoma chosensis* sp. nov., male hypopygium, details.
43. *Nephrotoma martynovi* sp. nov., male hypopygium, details.
44. *Nephrotoma atrostyla* sp. nov., male hypopygium, details.
45. *Limonia* (*Libnotes*) *perparvuloides* sp. nov., male hypopygium.
46. *Limonia* (*Limonia*) *juvenca* sp. nov., male hypopygium.
47. *Antocha* (*Antocha*) *platyphallus* sp. nov., male hypopygium.
48. *Gonomyia* (*Gonomyia*) *latifolia* sp. nov., male hypopygium.



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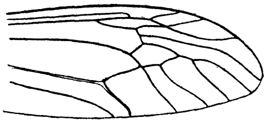

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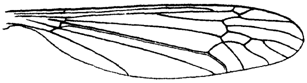

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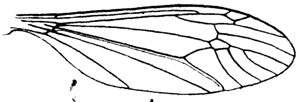

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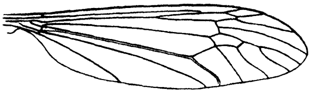

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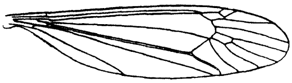

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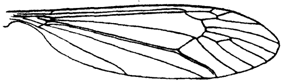

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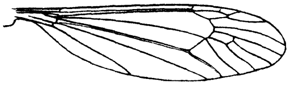

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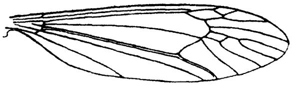

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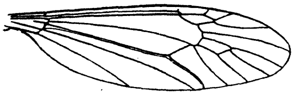

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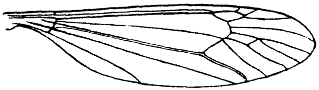

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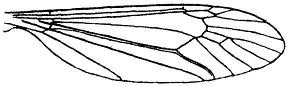

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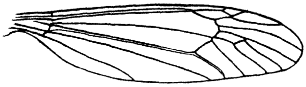

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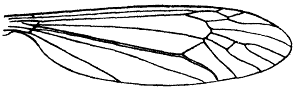

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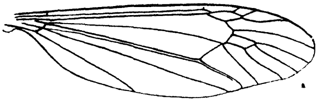

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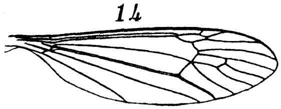

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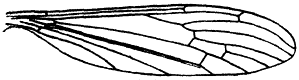

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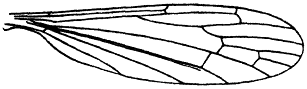

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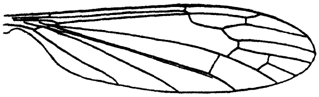

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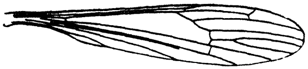

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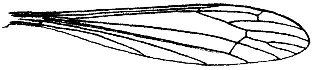

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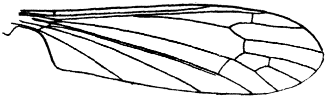

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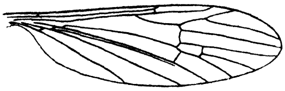

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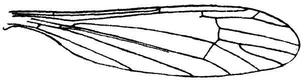

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PLATE 1.

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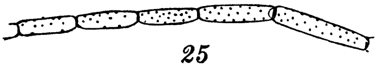

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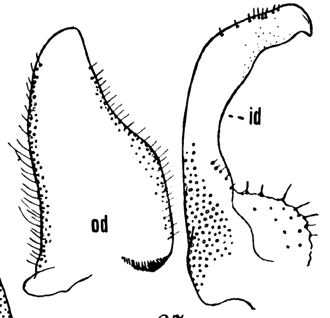

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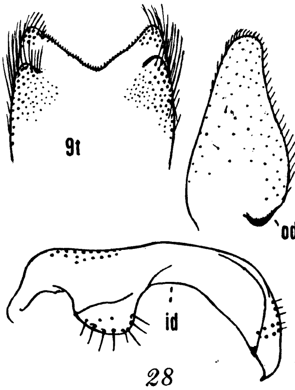

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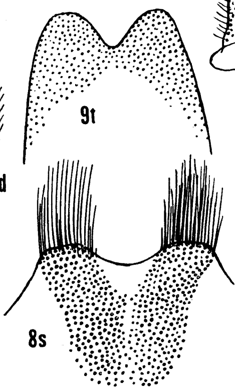

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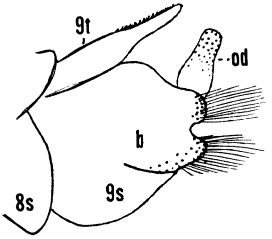

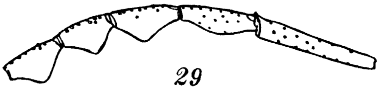

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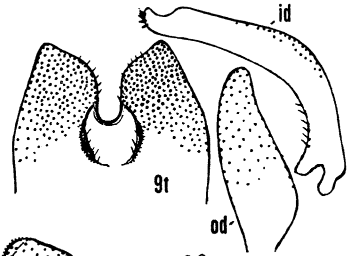

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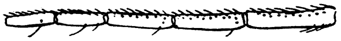

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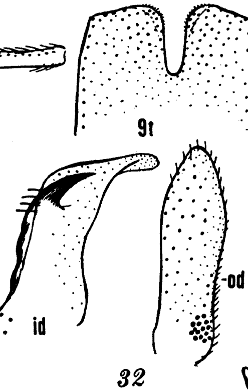

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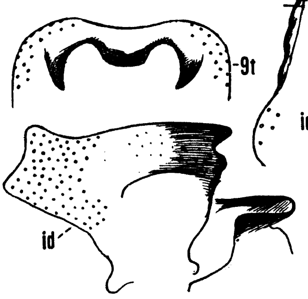

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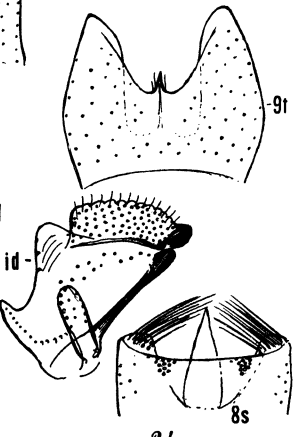

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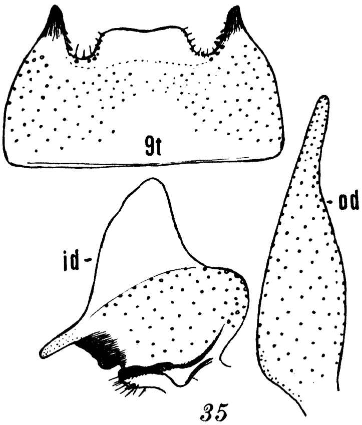

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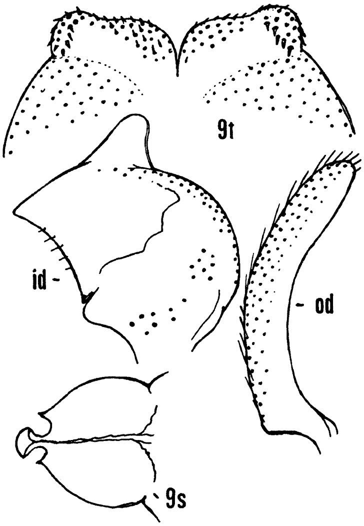

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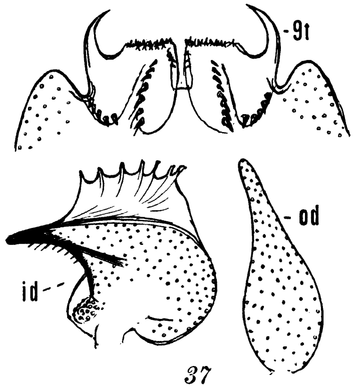

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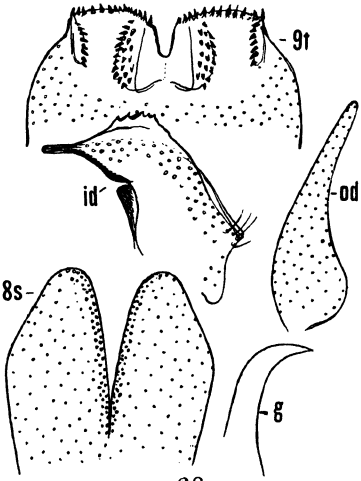

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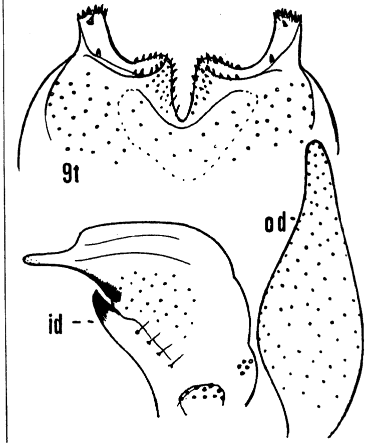

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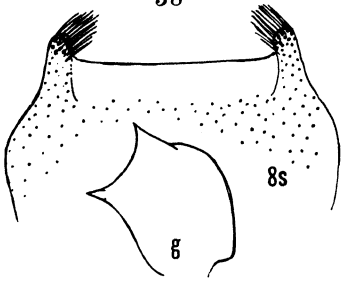

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PLATE 3.

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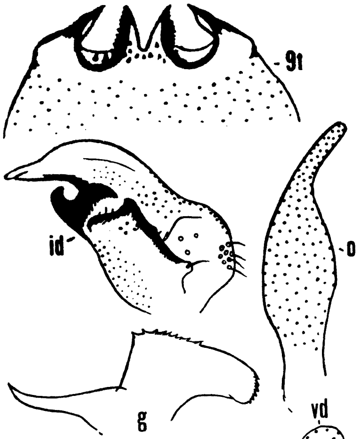

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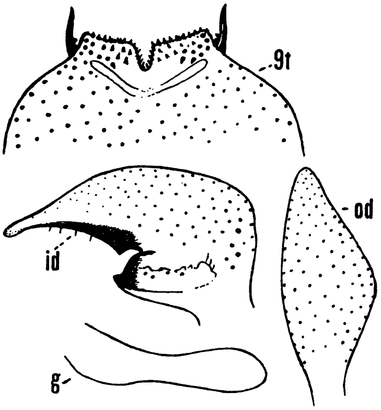

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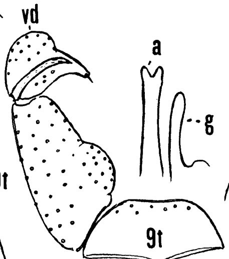

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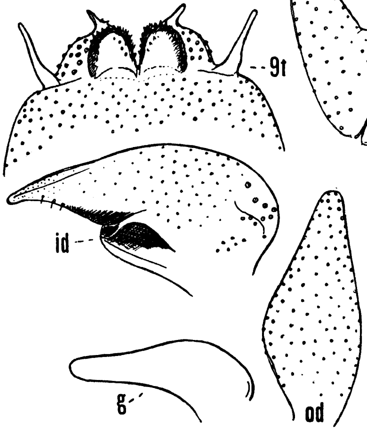

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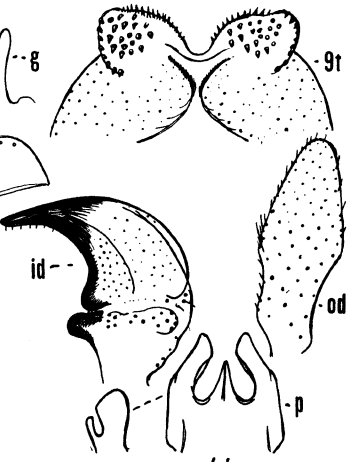

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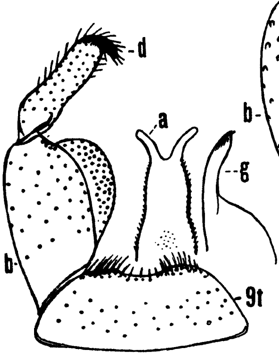

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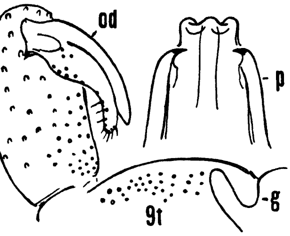

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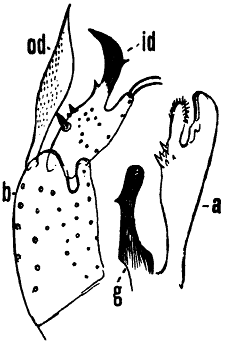

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PLATE 4.

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# NEW LONGICORN BEETLES FROM FORMOSA, II (COLEOPTERA: CERAMBYCIDÆ)

By J. LINSLEY GRESSITT

*Of the University of California, Berkeley*

The present paper is a continuation of a series begun as "New longicorns from the Japan Empire." [1] Herein are described as new eleven species of the tribes Lepturini and Molorchini of the subfamily Cerambycinæ. All the material dealt with in this paper was collected in Formosa by the author in 1932 and 1934. The types are preserved in the United States National Museum in Washington, D. C., the California Academy of Sciences in San Francisco, and the author's collection.

## LEPTURINI

### Genus PSEUDOPIDONIA Pic, 1900

**PSEUDOPIDONIA ÆNIPENNIS Gressitt sp. nov.**

Minute, subparallel; body dull grayish black, elytra dull bluish green, last two abdominal segments reddish testaceous, first and second antennal segments, anterior and ventral portions of head, including palpi and sides of frons, and legs, except tarsi, testaceous, extreme apices of third and fourth antennal segments slightly reddish, legs slightly dark on apices of femora above and external margins of tibiæ; body, except antennæ, largely clothed with fine, decumbent, testaceous hairs, which are longer and more obliquely inclined on elytra, a few long erect hairs on front and underside of head.

Head longer than broad, narrowed and elongate before eyes; longitudinally obliquely, then transversely obliquely narrowed behind; eyes almost entire, broader before than behind; vertex raised and slightly concave; frons broader than long; clypeus nearly as long as broad; mandibles long; last palpal segment broadly obliquely truncated at apex; entire dorsal surface, except mandibles, densely and finely punctured, more sparsely on clypeus. Antennæ as long as the body; scape arched, barely

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[1] Pan-Pacific Entomol. 9: 163–170; Philip. Journ. Sci. 55 (1934) 379–386; 57 (1935) 181–194.

reaching to neck; second segment longer than broad; third segment barely longer than scape; fourth, sixth, and seventh equal and hardly shorter than third; fifth one-third longer than fourth; eighth to last shorter and subequal. Prothorax slightly longer than broad, campanulate, slightly constricted near apex and base; apex two-thirds as broad as base; disc moderately swollen; surface minutely and densely punctured. Scutellum triangular, slightly longer than broad. Elytra slightly more than twice as long as broad, parallel, narrowed and rounded at apices; surface fairly heavily punctured on basal two-thirds, more finely posteriorly. Abdomen with the segments subequal in length, the last two slightly shorter. Legs fine; femora hardly swollen; tarsi with the first segment nearly as long as the two following in anterior and middle pairs, slightly longer in the hind pair, apical segment long, the claws testaceous. Length, 6 millimeters; breadth, 1.65.

Holotype, female, a unique, in the author's collection, taken by the author at Reimei, Hassenzan, Formosa, at an altitude of 2,350 meters, June 26, 1934.

Differs from all the known species of the genus in possessing entirely bluish green elytra. Possibly related to *P. albomaculata* Matsushita, but has the first segment of hind tarsi barely longer than following two segments united, instead of twice as long as in the latter, besides differing in coloration.

### PSEUDOPIDONIA SUBÆNEUS Gressitt sp. nov.

Minute and parallel; body black, head with the ventral and anterior portions, including sides of frons, testaceous, antennæ with the first two segments testaceous, the following reddish brown, becoming black towards apex, elytra dull greenish black, each with a testaceous band from base to one-third from apex, which is broad at base, covering humerus, gradually narrowing to its termination, with its internal margin parallel with suture and external margin oblique with a slight projection towards external margin of elytron one-third from base, ventral surface with prosternum and basal margin of first abdominal segment reddish testaceous, last two abdominal segments slightly dark reddish brown, legs, including coxæ, testaceous, tarsi and tibiæ externally black; body finely clothed with minute testaceous hairs, longer and less reclining on elytra.

Head barely longer than broad, gradually narrowed behind eyes towards neck; occiput minutely punctulate; eyes swollen, nearly round; frons, clypeus, and labrum each about twice as broad as long. Antennæ one-fourth longer than body; fourth, sixth, and seventh segments subequal, longer than scape, fifth nearly half again as long as scape, last four subequal. Prothorax nearly half again as long as broad; hardly constricted near apex and base; apex two-thirds as broad as base; disc swollen longitudinally, with almost a carina behind middle; surface densely and minutely punctulate. Scutellum triangular. Elytra very slightly concave at sides; apices narrowed and rounded, surface heavily punctured, more moderately at apices. Legs fine; tarsi elongate, first segment of hind pair longer than following two united. Length, 6.5 millimeters (elytra, 4.2); breadth, 1.7.

Holotype, male, a unique, in the author's collection, taken by the author at Hassenzan, Formosa, at an altitude of 1,300 meters, June 24, 1934.

This species is closely related to *P. ænipennis* Gressitt, although differing markedly in the coloration of the elytra. It has the prothorax longer, less constricted at apex and base, and more swollen above, the head is shorter and less abruptly narrowed at neck, the eyes are more rounded and the elytra are broader and more heavily punctured at apices.

### PSEUDOPIDONIA OCCIPITALIS Gressitt sp. nov.

*Male.*—Narrow, subelongate, antennæ and legs fine; testaceous and black; head reddish testaceous, except eyes, neck above, and region behind eyes, which are black, antennæ testaceous, with the apices of third and following segments and the apical segments dull, prothorax testaceous with the sides and upper part of swollen portion blackish, scutellum reddish brown, elytra testaceous with a narrow submarginal black stripe, which extends around apex to sutural angle, and a narrow sutural stripe, which broadens slightly before, but does not reach apex, ventral surface subrufotestaceous, marked with black on mesepisternum, sides of metasternum and first two abdominal segments, legs subrufotestaceous with apices of femora and outer sides of tibiæ and tarsi blackish; body thinly clothed with short, decumbent, golden hairs, head with a few long erect hairs, antennæ naked.

Head narrowed and abbreviated before eyes, narrowed and obliquely constricted behind eyes; eyes moderately large, swollen, rounded-oval, very slightly emarginate; occiput swollen, granulose; vertex slightly concave; frons twice as broad as long, granulose punctate at sides; labrum and clypeus broad, slightly punctate; maxillary palpi with last segment flattened, obliquely truncate and slightly rounded apically; genæ very short. Antennæ slightly longer than body; third segment longer than scape and shorter than fifth; fourth two-thirds as long as third and practically as long as sixth. Prothorax longer than broad, narrowly swollen above, swollen and subtuberculate at sides, constricted slightly near base and strongly near apex; surface granulose punctate. Scutellum longer than broad, rounded behind. Elytra long, slightly narrowed posteriorly, subrounded truncate apically, swollen near scutellum and heavily punctate on basal three-fourths. Ventral surface glabrous and shiny below lateral prothoracic swellings; breast and abdomen minutely granulose punctate; fore middle coxæ narrow; mesepimeron narrow internally. Legs long and fine; first segment of hind tarsus slightly longer than the following two united, the last segment subequal to the second.

*Female.*—Elytra shorter, last segment of maxillary palpi hardly broadened, antennæ barely as long as the body, largely dull brown, scape reddish, elytra with the two black stripes very broad, leaving only a narrow marginal and a moderate discal testaceous stripe, legs with the apical portions of femora and the tibiæ and tarsi largely blackish. Length, 8.5 to 10 millimeters; breadth, 2.2.

Holotype, male (No. 51014, United States National Museum), Taiheizan, northeastern Formosa, altitude 2,000 meters, May 10, 1932; paratype, male, Kyuhabon, near Musha, central Formosa, altitude 1,900 meters, May 21, 1932; paratopotype, female, Taiheizan, Formosa, May 8, 1932, and paratype, female, Sankakuho, near Musha, Formosa, altitude 2,100 meters, May 20, 1932; all taken by the author.

Closely related to *P. discoidalis* Pic, of Japan, but much narrower, with the maxillary palpi less broadened, the femora less thickened, the occiput and vertex reddish brown instead of black, and the femora largely testaceous instead of largely black.

### Genus LEPTURA Linnæus, 1758

#### LEPTURA (?) OCHRACEOVENTRA Gressitt sp. nov.

Elongate, shoulders broad, elytra somewhat narrowed posteriorly, their sides straight; largely shiny black above and ochraceous straw color beneath, antennæ with last half of the eighth segment, the ninth, the tenth, and base of the eleventh segments whitish testaceous, scutellum and the elytra near suture at base and a reversed parenthesis-shaped area at middle of each side ochraceous, the latter mark on each elytron not touching suture or margin and from above seeming to inclose a round black spot, a small subdetached lateral spot on each elytron before the parenthesis-shaped spot, underside of head, and last abdominal segment black, outer portions of fore and middle tibiæ narrowly, hind tibiæ and tarsi dull to black, labrum and genæ slightly ochraceous; body fairly naked, with sparse and very short obliquely inclined hairs, denser on the thoracic sterna and longer and more erect on head, pronotum, and apices of second to seventh antennal segments, abdomen glabrous; head rather finely punctate, basal antennal segments more finely and densely so, pronotum very finely and sparsely punctate, elytra more deeply, but finely so.

Head very long, equal to prothorax and narrower than its width at base, strongly constricted from posterior margin of eyes, which are prominent, swollen and rounded externally; preocular portion constricted and elongate, with the sides parallel; occiput subsulcate longitudinally; vertex depressed behind the antennal tubercles, which are broad and concave between; frons subparallel, medially grooved, apically depressed and separated from the clypeus by a transverse groove; clypeus large, broader than long; labrum short; genæ very large; maxillary palpi with the last segment large, twice as long as broad, transversely truncate apically. Antennæ as long as the body; the latter segments somewhat thickened, cylindrical, hardly broader at their apices; the basal segments gradually thickened and rounded at apices; scape thickened apically and slightly arched; second segment longer than broad; third segment longer than scape and one-third longer than fourth; fourth shorter than scape and three-fifths as long as fifth; fifth one-half longer than sixth; sixth to tenth slightly decreasing; eleventh subequal to ninth. Prothorax longer than broad, subcampanulate, constricted before apex, which is again dilated forming a collar, sides not prominent, acutely produced at base, which is three-fourths as broad as elytra; basal margin slightly sinuate. Scutellum narrow, subtriangular. Elytra long; shoulders broad; sides straight, apices truncate with the external angles strongly produced, the sutural angle less so, swollen near suture at base, behind which it is narrowly and obliquely concave, likewise slightly concave at each side of suture. Ventral surface impunctate; fore coxæ practically adjacent, prominent; abdomen with the segments subequal in length. Legs fine, the femora very slightly swollen; hind femora slightly sinuous; first segment of middle tarsi not as long as remaining segments combined, that of hind pair slightly longer. Length, 14 millimeters; breadth, 3.

Holotype, male, a unique, in the author's collection, taken by the author at Hassenzan, north-central Formosa, altitude 1,800 meters, June 24, 1934.

This species is almost identical in markings with *Strangalina basiplicata* (Fairmaire), of China, but the latter has the last segment of the maxillary palpi long, the prothorax less constricted anteriorly, more swollen medially, and less expanded basally, the scutellum bilobed apically, the elytra without a strong apical spine, and the metasternum with two thornlike projections posteriorly; further *basiplicata* has the mesothorax (except coxæ) and the metepisternum black and abdomen entirely reddish testaceous. *Leptura* (*?*) *ochraceoventra* is somewhat similar to *Eustrangalis viridipennis* Gressitt in structure, but does not have the prothorax strongly constricted before and behind or swollen in the middle, and therefore cannot enter the latter genus.

### Genus ANOPLODERA Mulsant, 1839

#### ANOPLODERA (?) TRICOLOR Gressitt sp. nov.

Elongate, prothorax narrow, elytra narrowed behind middle; black, with the elytra bright metallic green, the prothorax orange, the last abdominal segment, intercoxal process of first abdominal segment, apex of second antennal segment, and a line on the ventral side of second and third antennal segments dull orange, the palpi testaceous; body thinly clothed with short, pale hairs.

Head longer than broad, very strongly constricted behind eyes, the neck narrow; surface moderately finely punctate; eyes swollen, subtriangular, narrowly indented internally; frons squarish, longitudinally grooved to apical smooth portions; clypeus large, trapeziform; labrum short, fringed apically with testaceous hairs; palpi of each pair with their apical segments more than twice as long as broad, each thickest before apex and subtransversely truncated; vertex swollen at each side next to antennal supports, which are close; occiput broad and slightly depressed. Antennæ as long as the body, the first four segments punctate and shiny, the remaining segments dull and broadened; scape short, arched, slightly thickened towards apex; second segment broader than long; third and fourth segments equal to each other and to scape in length; fifth to tenth segments subequal and each slightly longer than fourth; eleventh longer than tenth. Prothorax campanulate, longer than broad, very slightly expanded basally; apex two-thirds as broad as base; base three-fifths as broad as elytra at base; basal margin concave on each side of middle, the middle portion of margin narrowly greenish black; surface finely and evenly punctate, clothed with a thin golden pile directed towards posterior part of disc. Scutellum black; triangular, the apex acute. Elytra highly metallic, with very deep and dense punctures; narrowed from shoulders to beyond middle, then slightly broadened before apex; apices rounded externally and transversely truncate, internal angles nearly right angles. Ventral surface clothed with silvery hairs; meso- and metasternum granulose; abdomen minutely punctate; fore coxæ prominent, conical, adjacent, angulate externally; abdomen not reaching to apices of elytra, first four segments subequal in length, the last longer. Legs with femora swollen near apices; tibiæ straight, hind tarsi as long as femora or tibiæ, the first segment equal in length to second and third combined and also to last segment; the second segment nearly twice as long as third. Length, 13 millimeters; breadth, 3.

Holotype, a unique, probably a male, in the author's collection; taken by the author at Hassenzan, Formosa, altitude 2,000 meters, June 26, 1934.

I have referred this species to *Anoplodera* because of the structure of the prothorax, but it is strikingly contrasted to the true members of the Holarctic genus, with its black head, orange prothorax, and heavily punctured metallic green elytra, which are narrowed after the basal portion as in *Strangalina*.

### Genus ANOPLODERMORPHA Pic, 1901

#### ANOPLODERMORPHA BINOTATA Gressitt sp. nov.

Small, abbreviate, narrowed posteriorly; black, the elytra shiny, entire abdomen and an irregular short oblique spot touching the shoulder of each elytron rufocastaneous, tarsal claws and tibial spurs light brown, palpi dark chesnut.

Head broader than prothorax, strongly constricted at neck, abbreviate in front of eyes, which are large and obliquely indented internally; occiput broad and punctate; vertex slightly depressed between antennal supports; frons very short, with an apical subtriangular glabrous area; clypeus twice as broad as long, with a few punctures; labrum short; last segment of maxillary palpi more than twice as long as broad, rounded at apex. Antennæ nearly as long as the body; basal five segments shiny black and punctate, remainder dull and clothed with grayish pubescence; scape arched, hardly thickened towards apex; second segment longer than broad, third and fourth segments equal in length and shorter than scape; fifth to ninth segments equal, tenth shorter and eleventh longer; sixth to last segments thicker. Prothorax appreciably longer than broad; sides parallel behind middle, apex narrowed, apical margin not expanded; base three-fifths as broad as base of elytra, not produced; surface finely and densely punctate. Scutellum triangular and dull. Elytra short, less than one and one-half times as long as head and prothorax united, shorter than abdomen, sides narrowed to beyond middle, then slightly expanded; apices transversely rounded-truncate; surface finely punctured in rows; a concave area in middle along suture. Body clothed below with pale hairs, fewer on latter part of abdomen, which is shiny. Femora swollen, the hind pair least so and slightly flexed; first segment of middle tarsi equal in length to second and third combined and to last, the first segment of hind tarsi nearly as long as remaining segments united. Length, 7 millimeters; breadth, 2.

Holotype, a unique, in the collection of the author, taken by the author at Pianan-Ambu, northern Formosa, altitude 1,750 meters, May 12, 1932.

Closely related in structure to *A. discale* Gressitt, of China, but differs in having the elytral spots smaller, darker, and centered more anteriorly, the abdomen light chestnut instead of black, the clypeus much shorter, the prothorax narrower with the apical margin not expanded, and the elytra shorter with the punctures in rows.

### ANOPLODERMORPHA BREVA Gressitt sp. nov.

*Male.*—Minute, abbreviated, narrowed posteriorly; body black, the elytra shiny metallic blue, abdomen, except first segment and basal portion of second segment, and femora, except bases and apices, pale orange-castaneous, labrum and palpi testaceous-brown; body clothed with short, suberect, black hairs.

Head broader than prothorax, abbreviated anteriorly; eyes large, oblong-ovate, slightly indented internally behind middle with an oblique angle; obliquely narrowed for a short distance behind eyes, then transversely constricted into a narrow neck; occiput very broad; vertex very slightly concave between the antennal tubercles, with a slight swelling above at each side; frons extremely short, broader than long, with a midlongitudinal line continued from base of occiput, which divaricates forming a glabrous, flattened triangle separated from clypeus by a slightly arched deep transverse groove; clypeus very large, convex, nearly as long as broad, slightly narrower at apex; labrum membranous, very short; last segment of maxillary palpus broadest in middle, subtruncate apically; genæ very short; upper portions of head fairly densely punctate, frons and clypeus more finely so. Antennæ nearly as long as the body; scape narrow, arched, not thickened at apex; second segment longer than broad; third segment shorter than fourth or scape; fifth longer than fourth, the following segments gradually slightly shorter, the last longer. Prothorax campanulate, longer than broad; sides meagerly swollen; disc arched; base not dilated, three-fifths as broad as elytra at base; surface less finely punctured than head, the punctures broader and shallower at sides. Scutellum narrowly triangular, dull black. Elytra broad at shoulders, narrowed in middle portion, slightly broader near apex than behind middle; apices subtransversely truncate, rounded slightly at both angles; slightly depressed in central portion near suture; surface regularly and finely punctate. Ventral surface finely granulose to punctate. Legs fine, the fore and middle tibiæ somewhat swollen, the hind pair less so; tarsi of each pair narrow, nearly as long as the respective tibiæ, first segment of middle pair subequal in length to following two segments, first segment of hind pair one and one-half times as long as following two segments.

*Female.*—Elytra dark lavender; antennæ slightly shorter, with the segments thickened. Length, 6 millimeters; breadth, 1.65.

Holotype, male (No. 3991, California Academy of Sciences, entomology), taken by the author at Arisan, central Formosa, altitude 2,250 meters, June 7, 1932; allotopotype, female, May 24, 1934, and paratopotype, male, June 6, 1932, in the author's collection.

Closely related in structure and form to *A. discale* Gressitt and *A. binotata* Gressitt, differing in its smaller size and its blue or violet elytra.

### Genus STRANGALINA Aurivillius, 1912

#### STRANGALINA ANGUSTISSIMA Gressitt sp. nov.

Elongate, extremely narrowed behind the middle, antennæ thickened apically, elytra shorter than abdomen; black, each elytron with a large basal discal colorless semitransparent area, which closely borders suture from behind scutellum to three-fifths distance from base, gradually narrowing to an acute ending, but hardly approaches nearer than half elytron width to external margin, tibial spurs and tarsal claws dull reddish brown; body finely clothed with short silvery pubescence, blacker on elytra, abdomen nearly glabrous, head with a few erect hairs, antennæ with short black hairs on basal segments and a few hairs at apex of each segment; head minutely and densely punctured, breast finely granulose punctate, abdomen minutely punctulate, extremely so on basal portion of each segment.

Head broad; anterior portion parallel-sided but abbreviated; eyes strongly swollen, subglobose; vertex narrow, concave; frons squarish; clypeus trapezoidal; last segment of maxillary palpi narrow, subobliquely truncate apically. Antennæ as long as the body (male), the segments thickened apically; scape short, slightly thickened; second segment broader than long; third two-thirds again as long as scape; fourth two-thirds as long as third; fifth hardly shorter than third; sixth to tenth slightly shorter; eleventh equal to seventh. Prothorax half again as long as broad, not expanded basally, constricted at apex, very slightly swollen just before middle, slightly narrowed between middle and base; dorsal surface meagerly swollen; surface moderately punctured on upper part of disc, very finely near base and on sides; base three-fourths as broad as elytra at base, the posterior margin broadly produced in middle. Scutellum narrowly triangular. Elytra very strongly narrowed after basal third, reaching just beyond third abdominal segment, narrowly, and slightly obliquely, truncate at apex. Abdomen very fine, cylindrical, each segment excavated below. Legs very fine, the hind pair exceedingly long, with femora reaching to elytral apices, tibiæ slightly sinuate, tarsi longer than tibiæ and exceedingly fine, with the first segment slightly less than following united and the second hardly as long as the remaining united. Length, 11.7 millimeters (9.7 to elytral apices); breadth, 2.

Holotype, male, a unique, in the author's collection, taken by the author at Hassenzan, Formosa, altitude 1,500 meters June 26, 1934.

Somewhat similar to *Strangalina lineigera* (Fairmaire), but much more attenuated and the elytra much shorter and narrower and the abdomen and hind tarsi much longer and finer.

**STRANGALINA SUTURALIS Gressitt sp. nov.**

Somewhat abbreviated, not extremely narrowed posteriorly; black, each elytron with a large testaceous discal area, close to suture and about half as wide as elytra, narrowed posteriorly, extending from base to one-seventh from apex, leaving a narrow sutural and wide marginal black stripe, palpi, tibial spurs, and tarsal claws partly reddish brown; body moderately clothed with a thin, pale golden pubescence, antennæ and hind tarsi nearly naked.

Head practically as broad as prothorax at base, slightly longer than broad, densely and minutely punctured; eyes moderate, rounded oval; vertex broad, slightly concave and finely grooved midlongitudinally; frons broader than long; clypeus trapeziform; labrum twice as broad as long; last segment of maxillary palpi subcylindrical, at least three times as long as broad; genæ slightly broader than long. Antennæ (female) about two-thirds as long as body, the posterior segments slightly thickened (last three missing); scape subcylindrical; second segment slightly longer than broad; third segment half again as long as first; fourth three-fourths as long as third; fifth slightly longer than fourth; sixth to eighth subequal, shorter than scape. Prothorax four-fifths as broad as elytra, slightly longer than breadth at base; base very slightly expanded; middle slightly swollen; apex narrowed but not transversely grooved or collared; surface finely punctured. Scutellum subequilaterally triangular, slightly rounded posteriorly. Elytra slightly abbreviated, not reaching apex of abdomen, slightly narrowed posteriorly, but not strongly constricted, one-half as broad near apex as at base; apices narrowed and obliquely truncated, subacuminate externally; surface sparsely and finely punctured. Abdomen as broad and as deep as thorax, the middle segments twice as broad as long. Hind legs long, tarsus longer than tibiæ, the first segment slightly shorter than following united, second segment subequal to remaining and double the third. Length, 12.4 millimeters (elytra, 7); breadth, 2.7.

Holotype, female, a unique, in the author's collection, taken by the author at Bukai, central Formosa, altitude 1,250 meters June 14, 1934.

Similar to *S. lineigera* (Fairmaire) and *S. angustissima* Gressitt, but shorter, with the elytra less constricted and attenuated posteriorly. The elytral marking consists of a large pale testaceous discal area and the rest of the body is black.

### STRANGALINA SUBAPICALIS Gressitt sp. nov.

Subelongate, narrowed posteriorly; black, antennæ with ninth and tenth, apex of eighth, and base of last segment whitish testaceous, elytra pale castaneous with a narrow longitudinal discal stripe, commencing near base and ending in a union with a marginal spot before apex, which continues externally around apex to suture, two marginal spots, one behind humerus, the other before middle, and the suture and external margin, narrowly, of black, fore and middle femora, basal third of hind pair and fore tibiæ internally orange-testaceous; ventral surface of body and pronotum apically and basally, particularly on external angles, clothed with a dense, closely adpressed, golden pubescence, which hides the surface.

Head nearly as broad as prothorax at base, longer than broad, narrowed and subelongated anterior to eyes, transversely constricted at base of eyes; occiput parallel-sided, densely punctate, as are other parts of head except apex of frons; vertex narrow, acutely raised at each side between antennal insertions, narrowly concave in middle; frons nearly square; labrum very short, with an apical fringe; last segment of maxillary palpi somewhat swollen in middle, less than three times as long as broad, transversely truncated apically; eyes nearly round; genæ squarish. Antennæ (female) slightly longer than body, the segments thickened in posterior half, scape thickened towards apex; second segment longer than broad; third one-third again as long as scape; fourth subequal to scape; fifth subequal to third; sixth and following gradually slightly shorter; last equal to fifth. Prothorax four-fifths as broad as elytra, slightly longer than broad; narrowed anteriorly; sides nearly straight, hardly swollen in middle, very slightly expanded basally; constricted before the apex, with a slightly expanded collar; surface minutely punctured at sides, with deeper and sparser punctures above and a midlongitudinal impunctate stripe. Scutellum narrowly triangular. Elytra slightly abbreviated, evenly narrowed to near apex, not strongly constricted in middle, narrowed and subobliquely truncated at apices; surface moderately strongly punctured basally, more finely so posteriorly. Abdomen broad, the middle segments twice as broad as long. Hind legs with the femora reaching beyond elytral apices, the tarsi shorter than the tibiæ, with the first segment subequal to the following united, and the second shorter than the remaining united. Length, 12 millimeters (elytra, 6.7); breadth, 2.75.

Holotype, female, a unique, in the author's collection, taken by the author at Hassenzan, north-central Formosa, altitude 2,250 meters, June 27, 1934.

Very closely related to *S. nymphula* (Bates), of Japan, and *S. lineigera* (Fairmaire), of China, but the prothorax less constricted apically and the elytra more narrowly truncated apically and more abbreviated than in both.

### MOLORCHINI

### Genus LEPTEPANIA Heller, 1924

**LEPTEPANIA MINUTA Gressitt sp. nov.**

Very narrow, parallel, dorsoventrally compressed; prothorax with a large concavity at each side; subglabrous; shiny dark chestnut, nearly black on the pronotum, elytra very dark brown with a transverse, antemedian band of pale straw color, which forms an irregularly triangular spot on each elytron, the spot of each side with its base at the middle and its apex near the base of the elytron; prothorax, legs and antennæ internally clothed rather sparsely with moderately long, erect brown hairs, the swollen portions of femora glabrous, head and elytra clothed with shorter hairs, abdomen glabrous with a few straggling setæ at margin and apex; head and prothorax punctured with broad, shallow, variolate punctures, which are reticulated, elytra with a few irregular moderately deep punctures, ventral surface glabrous, with a few punctures on sides of thorax and basal abdominal segments.

Head very short, as broad as elytra and practically as broad as the broadest portion of prothorax and abdomen, very slightly constricted behind eyes; neck broad; occiput short; vertex level in middle, slightly swollen at sides near antennal tubercles which are very low and somewhat directed laterally; eyes small, divided, with the ventral lobe lateral, subcircular and hemispherical, the dorsal lobe apart, behind antennal tubercles and very narrow; frons convex, broader than long, narrower at apex than base; clypeus small, apical margin indented; labrum very small, exposing mandibles; genæ moderate, their front angles prominent; palpi minute, the apical segments subfusiform. Antennæ reaching to last fifth of body; the segments swollen, but mostly slightly compressed laterally and punctured on the sides; scape subpyriform, straight, internally; second segment longer than broad; third segment slightly longer than scape and subequal to fifth and sixth; fourth shorter than seventh and longer than eighth; ninth and tenth successively shorter; eleventh subequal to seventh, fusiform and acute. Prothorax much longer than broad, broader than elytra, broadest near base, apex nearly as broad, constricted to a narrow basal collar, which is three-fourths as broad as elytra, parallel-sided from above for anterior three-fifths; lateral concavities fringed internally with pale hairs. Scutellum minute, triangular. Elytra narrow, parallel-sided; slightly more than one-third as long as abdomen; rounded apically, slightly concave dorsally. Abdomen long, dorsally compressed, broadest behind middle, pleura with an oval depression on each segment. Legs short, fine; femora very strongly clavate for more than their apical halves, the swollen parts laterally compressed. Tarsi with the first segment of anterior pair very broad, with a spreading fringe of bristles, the third segment less so; middle and hind pair with the first segment normal and equal in length to the following two segments, the third segment dilated and fringed. Length, 3.75 millimeters; breadth, 0.6.

Holotype, probably a male, a unique, in the author's collection, taken at Hassenzan, Formosa, altitude 1,200 meters, June 20, 1932, by the author.

Very similar to the genotype, *L. longicollis* Heller,[1] of Luzon, differing principally in size and coloration, the proportions of the prothorax also being slightly different.

## JAPANESE NAMES OF NEW SPECIES

1. *Pseudopidonia ænipennis* sp. nov. Aobane-yamanohana-kamikiri.
2. *Pseudopidonia subæneus* sp. nov. Ko-yamanohana-kamikiri.
3. *Pseudopidonia occipitalis* sp. nov. Taiwan-sesujihana-kamikiri.
4. *Leptura* (?) *ochraceoventra* sp. nov. Kibara-hana-kamikiri.
5. *Anoplodera* (?) *tricolor* sp. nov. Aobane-hana-kamikiri.
6. *Anoplodermorpha binotata* sp. nov. Futahoshi-chibi-hana-kamikiri.
7. *Anoplodermorpha breva* sp. nov. Ruribane-chibi-hana-kamikiri.
8. *Strangalina angustissima* sp. nov. Taiwan-hoso-hana-kamikiri.
9. *Strangalina suturalis* sp. nov. Sesuji-hoso-hana-kamikiri.
10. *Strangalina subapicalis* sp. nov. Atomon-hoso-hana-kamikiri.
11. *Leptepania minuta* sp. nov. Chibi-kobane-kamikiri.

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[1] Philip. Journ. Sci. 10 (1915) 35.

# NEW LONGICORN BEETLES FROM THE PHILIPPINES BORNEO, AND SIAM (COLEOPTERA: CERAMBYCIDÆ)

By J. LINSLEY GRESSITT

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The present paper deals with nine new species and three new genera of the subfamilies Disteniinæ, Lepturinæ, and Lamiinæ. Of the Disteniinæ are described a new *Distenia* from Siam and a new *Noemia* from Mindanao, of the Lepturinæ a new *Ocalemia* from Luzon and four new species of one new genus and one new species of another genus from British North Borneo, and of the Lamiinæ is described a new species of a new genus of the tribe Atossini from Siam.

For all the material herein described the author is greatly indebted to Mr. W. S. Fisher, of the United States National Museum, who kindly loaned this material for study. Most of the species described as new in this paper are from the C. F. Baker collection. All the types are preserved in the United States National Museum, Washington, D. C.

## DISTENIINI

### Genus DISTENIA Serville, 1825

**DISTENIA FULVIPENNIS Gressitt sp. nov.**

Elongate, narrowed posteriorly; brown, the head and prothorax nearly black, abdomen dull brown, first three antennal segments, mouth parts, except portions of mandibles, and legs dull reddish brown, lighter on tibiæ and tarsi, elytra and fourth to last antennal segments fulvo-testaceous, posterior margins of first, second, and fourth abdominal segments narrowly yellowish; entire body clothed with fine, tawny pubescence, thickest on breast; scape, head, and prothorax with a very few fine erect hairs; third to last antennal segments clothed internally with a few very long hairs, recumbent in the type specimen.

Head slightly longer than broad, but slightly narrowed behind eyes, very finely grooved medially from base to apex of vertex; eyes twice as high as wide, broader below than above, concave anteriorly; vertex rounded-concave above and anteriorly; mandibles small; maxillary palpi fairly large, the last segment strongly thickened in middle internally, subtriangular (male). Antennæ slightly more than half again as long as body; scape thickened in posterior half, pedunculate, bent and slightly flattened basally, surface minutely granulose punctate; second segment broader than long; third segment longer than scape, equal to fourth; the following gradually shorter. Prothorax broader than long, moderately constricted near base and apex, strongly armed at each side with a broad-based, slightly upward directed, subacute tubercle; disc transversely impressed before and behind and furnished at each side with three blunt tubercles, two before and one behind, also with a slightly raised narrow middle area; surface very minutely punctate as is dorsal part of head. Scutellum as long as broad, rounded behind. Elytra narrowed posteriorly, straight-sided; apices narrowed and bidentate, the sutural tooth longer; disc with two weak longitudinal ridges, the outer one continuing to near apex, the inner one only perceptible near base, and five rows of deep punctures, extending to about middle, one subsutural, one submarginal, one bordering externally each of the two ridges and the other extending posteriorly from humerus; entire surface extremely minutely punctulate and marked with microscopic dark dots. Legs moderate; femora slightly swollen, the hind pair not reaching elytral apices; hind tarsus with the first segment shorter than the following segments combined. Length, 19.5 millimeters; breadth, 4.

Holotype, male, a unique (No. 51007, United States National Museum), Chiengmai, Siam, April 7, 1928, Dr. and Mrs. J. W. McKean.

Differs from *D. gracilis* Blessig, of Japan and Amur, in the elytra being furnished with five definite rows of strong punctures on basal half and in having the elytra, most of the antennæ, and part of the legs very light tan. Apparently related to *D. dohertii* Gahan, of India, but the latter has four, instead of five, rows of punctures, and has some punctures between the rows and at the apices of elytra; the coloration is also slightly different.

## Genus NOEMIA Pascoe, 1857

### NOEMIA MINDANAOENSIS Gressitt sp. nov.

Fine, elongate, slightly narrowed posteriorly; dull brown, head and prothorax shiny black with the exception of the mouth parts which are brown, antennæ tawny brown, the segments darker at apices, elytra brown with a somewhat greenish tinge, legs reddish brown, the bases of femora pale testaceous; body thinly clothed with fine, erect hairs of moderate length, antennæ with very long, fine hairs internally, generally decumbent and not easily seen, body also clothed with a very fine silvery pubescence, particularly noticeable on underside of body and on prothorax at apex, base, and sides, the disc of pronotum nearly glabrous with a very few shallow scattered punctures near base.

Head considerably longer than broad, moderately narrowed behind eyes and strongly constricted before them; occiput with a fine, low carina, which hardly reaches vertex or neck; eyes lateral, subreniform, much higher than long, finely faceted; vertex moderately broad, slightly concave, abruptly declivitous anteriorly; clypeus and labrum broad, with their apical margins straight. Antennæ one and three-fourths times as long as body; scape pedunculate, and cylindrically swollen after first third; second segment as broad as long; third segment slightly shorter than fourth; following nearly equal in length. Prothorax slightly longer than broad, slightly narrower at apex than base, bluntly swollen at each side in middle, constricted before and behind middle. Scutellum minute, bluntly triangular. Elytra long, parallel, deeply punctured in about nine longitudinal rows; apices narrowed and rounded. Legs fine; femora slightly swollen; tarsi very short, first segment of hind pair shorter than the following two segments united. Length, 9 to 10 millimeters; breadth, 1.7.

Holotype female (No. 51006, United States National Museum), allotopotype, male, and paratopotype, male (U. S. Nat. Mus.) and paratopotype, male (author's collection), Zamboanga, Mindanao, Baker collection; paratype, female, Silipon, Bukidnon, Mindanao, collected by Philips, in the author's collection.

This species differs from *Noemia negrosensis* Aurivillius in having brownish antennæ, from *Noemia sibuyanensis* Aurivillius in lacking any elytral spots, from *Nericonia fuscicornis* Aurivillius in lacking silvery bands, and from *Nericonia opacella* Aurivillius in having the elytra greenish coppery brown, instead of black. The present species was ticketed as being identified as a *Nericonia* by Aurivillius, but is distinctly not of that genus. The specimen from Silipon in my collection has the elytra greener, the scape yellower, and the rest of the antennæ darker.

### LEPTURINI

#### Genus STENOLEPTURA Gressitt novum

Head very broad, shortened anteriorly, dorsoventrally compressed, fairly plane above; vertex hardly swollen at sides; occiput very broad; eyes more or less kidney-shaped, closer anteriorly than posteriorly; maxillary palpi fusiform, thickest near base, bluntly pointed apically. Antennæ shorter than body, the posterior segments slightly thickened, but cylindrical, not broadened at apices. Prothorax strongly narrowed anteriorly, very broad basally, the angles covering fronts of humeri, nearly as broad as the base of elytra; sides nearly straight, hardly constricted near base; basal margin fairly strongly produced posteriorly at middle. Scutellum more or less an equilateral triangle. Elytra not strongly narrowed posteriorly, nearly parallel for their posterior two-thirds; apices obliquely truncate and strongly acuminate externally, the internal angles obsolete. Fore coxæ broad basally and narrowed apically. Hind tarsi very long, strongly compressed laterally, the first segment longer than following, second segment longer than remaining, at least three times as long as third and nearly twice as long as last.

*Genotype.*—*Stenoleptura sandakanus* Gressitt sp. nov.

*Range.*—British North Borneo (Sandakan).

This genus is closely related to *Strangalina* Aurivillius, but differs in its smaller size, and in being narrower at shoulders and less narrowed posteriorly. The head is very short and broad and dorsoventrally compressed, not declivitous from the vertex; the antennæ are shorter and thicker; the second segment of the hind tarsus is longer. The prothorax is very broad basally with the angles covering anterior portion of humeri and the middle produced over base of scutellum; it is not constricted before the apex or swollen in the middle. The second segment of the hind tarsus is at least three times as long as the following segment and nearly twice as long as the last segment.

### STENOLEPTURA SANDAKANUS Gressitt sp. nov.

Minute, laterally compressed, moderately narrowed posteriorly; black, each elytron with a basal ochraceous spot extending from margin over humerus to scutellum and continuing posteriorly as a narrow discal line to three-fifths from base, approaching rather close to suture, head reddish brown on sides of frons, genæ, apical portions of clypeus and labrum and palpi, occipital angles testaceous, antennæ dark brown, the first two segments and bases of fourth and fifth segments dull reddish brown, the last four segments lighter brown, coxæ, bases of femora and tarsi except first segment of each pair dull testaceous; antennæ and body densely clothed with pubescence, head and prothorax rather sparsely clothed, that on elytra subreclining and giving a golden brown effect, that on underside fine and dense, closely adpressed, and somewhat silvery.

Head strongly flattened and broadened, subabbreviated anteriorly; neck constricted close behind eyes, punctate; eyes large, reniform, emarginate internally at middle, distant; occiput very wide, vertex but slightly concave; frons nearly twice as broad as long; clypeus broader than long, narrowed apically, punctate; labrum more than twice as broad as long, punctate; mandibles moderately long; maxillary palpi long, the last segment oval and narrowly truncated apically; genæ very short, punctate. Antennæ inserted rather distantly and before middle of eyes, four-fifths as long as the body (female); scape narrow, cylindrical; second segment barely longer than broad; third longer than scape; fourth subequal to scape and fifth; sixth and seventh subequal; eighth, ninth, and eleventh subequal; tenth shorter; seventh to tenth segments cylindrical. Prothorax broader than long, strongly narrowed anteriorly; base practically as broad as shoulders, its angles hardly dilated; apex slightly more than half as broad as base; sides almost straight; anterior portion of disc narrowly swollen and moderately steeply inclined anteriorly; basal margin bisinuate; surface fairly deeply punctured at sides, less so above. Scutellum triangular, longer than broad. Elytra very narrow, but slightly narrowed beyond basal third; apices obliquely emarginate-truncate, the external angles strongly acuminate, the internal barely toothed; surface minutely and fairly evenly punctured throughout. Ventral surface minutely punctulate; fore coxæ rather broad basally; abdominal segments progressively shorter. Legs long, the hind pair extremely so; tibiæ slightly, and tarsi strongly compressed laterally; hind tarsus as long as tibiæ, first segment longer than following combined, second longer than remaining combined and over three times as long as third, which is no broader than the preceding. Length, 8.4 millimeters; breadth, 1.7.

Holotype, female, a unique (No. 51008, United States National Museum), Sandakan, British North Borneo, Baker collection.

Similar in markings to *longitarsis* Gressitt, but larger.

### STENOLEPTURA RUFOANTICUS Gressitt sp. nov.

Very narrow, shoulders not expanded, slightly narrowed behind; largely reddish orange anteriorly and mostly blackish behind, head orange with the exception of eyes, apices of mandibles, and apical maxillary segments, which are blackish, antennæ with the first two segments black, reddish externally at bases and apices (following segments missing), prothorax and scutellum entirely reddish orange, each elytron black with an ochraceous-orange area which covers the base, including humerus, and continues along the suture, gradually narrowing, to slightly beyond middle and an ochraceous apical area, slightly longer than broad, which covers the apex except for edges, ventral surface with ground color largely orange on thorax and black on abdomen, legs with the coxæ, basal portion of femora, and last four tarsal segments ochraceous, the remainder black, anterior femora largely pitchy, apical portion of first segment of hind femora dull ochraceous; body largely clothed with dense golden pubescence, giving a golden appearance to abdomen and posterior portion of elytra near suture, the pubescence black on sides of elytra and black portions of legs.

Head dorsoventrally compressed, slightly longer than broad, tranversely constricted slightly behind eyes; eyes small, but moderately swollen, subreniform, distant; vertex slightly sulcate; last segment of maxillary palpi subfusiform, blunt at apex, hardly more than twice as long as broad; genæ moderate. Prothorax longer than broad; base practically as broad as elytra at base; apex slightly constricted, three-fourths as broad as base before constricture; sides straight; disc very slightly swollen; surface microscopically punctulate. Scutellum triangular, slightly longer than broad. Elytra long, straight-sided, slightly narrowed; apices narrowed and strongly obliquely truncated, acuminate externally. Abdomen with segments gradually diminishing in length. Hind legs with the femora nearly reaching elytral apices; tarsi barely longer than tibiæ, strongly compressed, first segment one-third again as long as following united, second over half again as long as remaining united. Length, 10.6 millimeters; breadth, 1.9.

Holotype, female, a unique (No. 51009, United States National Museum), Sandakan, British North Borneo, Baker collection.

Differs from *flavovittata* Aurivillius (described as a *Strangalia,* and apparently a *Stenoleptura*), in having the head, prothorax, and chest entirely reddish orange, instead of largely black; the elytral stripe extends but slightly beyond middle and is not dilated posteriorly.

### STENOLEPTURA PRODUCTICOLLIS Gressitt sp. nov.

Narrow, head as broad as elytra, elytra narrowed behind base; black, the antennæ blackish brown, bases of segments paler, elytra with a bracketlike testaceous marking on each side forming a zerolike marking, subrounded internally, quadrilateral externally, longer than broad, broader anteriorly than posteriorly, front and back sides wider than lateral sides, interrupted only at scutellum and suture, not touching external margin, external portion of bases of hind femora slightly pale, last four tarsal segments of each pair and posterior portion of hind tarsi ochraceous; body fairly densely clothed with fine pale pubescence, giving a silvery effect to abdomen, antennæ with short black hairs at apices of segments, particularly third to fifth.

Head as broad as long, nearly as broad as elytra at base, dorsoventrally compressed; neck emarginately constricted behind eyes; eyes fairly large and long, subreniform, more distant behind than before; preocular portion much abbreviated; clypeus punctured; maxillary palpi with the second and third segments thickened apically, the last segment thickest near base and acutely attenuated apically; genæ very short. Antennæ about three-fourths as long as body; scape almost straight, subcylindrical; second segment practically as broad as long; third segment one-third longer than scape; following segments subequal to third, gradually decreasing (last two missing). Prothorax longer than broad, narrowed anteriorly, constricted at apex above; base practically as broad as elytra; sides nearly straight; disc strongly and narrowly swollen anteriorly, abruptly declivitous at apex. Scutellum subequilaterally triangular. Elytra narrowed at end of basal quarter, subparallel from there to near apex; apices narrow, strongly obliquely truncated, produced acuminately externally; surface minutely punctulate. Hind legs considerably longer than body; first segment of hind tarsi longer than following united, second segment three times as long as third segment, nearly twice as long as last. Length, 7.6 millimeters; breadth 1.6.

Holotype, male, a unique (No. 51010, United States National Museum), Sandakan, British North Borneo, Baker collection.

Quite distinct from the other members of the genus with its anteriorly and narrowly produced disc of pronotum and the prominent anterior zerolike circle and posterior rounded spot of testaceous on elytra.

### STENOLEPTURA LONGITARSUS Gressitt sp. nov.

Minute, shoulders narrow, but slightly narrowed posteriorly; black, antennæ with the last segment dull ochraceous, the preceding brownish black, elytra light castaneous, becoming pitchy behind the middle and black towards apices, forelegs with the femora dull ochraceous and the remainder dull brown, middle and hind tarsi and the abdomen posteriorly slightly pitchy brown;

elytra fairly densely clothed with subreclining golden hairs, ventral surface and prothorax moderately densely clothed with fine pale golden pubescence, legs somewhat more coarsely clothed, antennæ with short black hairs at sides of apices of segments, particularly the third to eighth.

Head much abbreviated anteriorly, swollen laterally, as broad as long; preocular portion but half as long as basal portion; neck constricted almost immediately behind eyes; eyes large, broad anteriorly, more distant behind than before, narrowly emarginate internally; vertex fairly even; frons short and strongly narrowed apically; clypeus and labrum very small; genæ almost obsolete. Antennæ three-fourths as long as the body (male); the posterior segments thickened and cylindrical, the tenth barely twice as long as thick; scape short, thickened towards apex; second segment hardly longer than broad; third segment slightly longer than scape; fourth slightly shorter than third, equal to fifth; fifth to tenth gradually shorter; eleventh equal to sixth. Prothorax slightly longer than broad, narrowed anteriorly, slightly constricted at apex; base as broad as shoulders, produced over base of scutellum, the angles covering front of humeri; sides nearly straight; disc moderately swollen, slightly laterally compressed anteriorly; surface minutely granulose punctate. Scutellum subequilaterally triangular. Elytra nearly parallel, but slightly narrowed beyond basal third; apices obliquely slightly emarginate-truncate, acuminately produced externally; surface moderately punctured. Hind legs with the tarsi considerably longer than tibiæ, the first segment slightly longer than the following united, the second segment nearly half again as long as the remainder united. Length, 5.5 millimeters; breadth, 1.2.

Holotype, male, a unique (No. 51011, United States National Museum), Sandakan, British North Borneo, Baker collection.

Distinguished from the other members of the genus by its strikingly broad, short, and anteriorly abbreviated head. The markings are somewhat similar to those in *sandakanus* Gressitt.

### Genus ACANTHOLEPTURA Gressitt novum

Narrow, subabbreviated anteriorly, laterally compressed. Head nearly twice as long as broad, nearly as broad as prothorax at base; eyes moderately swollen, subreniform, very minutely faceted; neck constricted immediately at base of eyes; vertex with the antennal insertions very close and narrowly concave between them; frons higher than wide, the apical triangular area punctured deeply like rest of head; genæ very long; last segment of maxillary palpi three times as long as broad, thickest near base, subobliquely truncated apically. Antennæ nearly one-third longer than the body in the male and subequal to the body in the female; the posterior segments cylindrical; second segment longer than broad; third subequal to scape, barely longer than fourth and but three-fourths as long as fifth; fifth to tenth gradually shorter; last one-third longer than fifth. Prothorax narrow, three-fifths as broad as elytra, hardly swollen at sides, fairly strongly swollen above, not expanded at base, nearly straight-sided, rather widely constricted before apex, with a very slightly dilated apical collar; disc and sides glabrous, nearly impunctate; each side with an oblique constriction near base. Scutellum minute and narrow. Elytra two and one-half times as long as breadth at base, straight-sided, wedge-shaped, not constricted, more than half as broad as base before last fifth; apices obliquely emarginate truncate with the external angles produced into a strong acute spine; surface shiny, but with large punctures. Fore coxæ narrowed apically, approximate; mesosternal intercoxal process moderately narrow; metepisternum largely glabrous, impunctate and highly polished. Middle femora fairly strongly swollen before apices; hind legs not exceedingly long, the tarsi hardly as long as the tibiæ, with the first segment slightly longer than the following united, the second segment shorter than the remaining and less than twice as long as the third, the first laterally compressed, apparently not grooved below, but very hairy, the second and third dorsoventrally compressed and padded beneath.

*Genotype.—Acantholeptura glabropleura* Gressitt sp. nov.

*Range.*—British North Borneo (Sandakan).

This genus is related to *Eustrangalis* Bates, *Strangalina* Aurivillius, and *Ocalemia* Pascoe, but differs from all of them in having the third antennal segment shorter than the fifth and no longer than scape, the metepisternum parallel-sided for most of its length and the elytra rather short and not strongly narrowed as in the latter two. It agrees with *Eustrangalis* in having the elytra spined externally at apices and the second tarsal segment flattened, but differs in having the last maxillary palpal segment longer and the prothorax not strongly constricted behind the swollen middle, besides the aforementioned characters.

**ACANTHOLEPTURA GLABROPLEURA** Gressitt sp. nov.

Rather abbreviated posteriorly, not strongly narrowed; black, antennæ with the apex of the eighth, the ninth, and more than half of the tenth segment testaceous, palpi and femora, except apices of anterior and middle pairs and apical third of hind pair, reddish brown, each elytron marked with reddish brown spots, except for the large apical spot which is testaceous, as follows: Two longitudinal discal stripes from base to end of first quarter, the inner one longer and expanded towards suture in middle, side with an oblong spot below humeral angle, a narrow submarginal spot one-third from base, just behind middle, which extends internally and slightly obliquely anteriorly as an incomplete fascia to midline of elytron, a free subapical testaceous spot which is hardly longer than broad, apical margins of first four abdominal segments testaceous brown; head with a few pale long erect hairs, antennæ with a few short black bristles on underside of third to fifth segments and at apices of following ones, elytra sparsely clothed with obliquely inclined reddish bristles, one from each puncture, remainder of body clothed with a dense silvery brown pubescence except for pronotum which is nearly glabrous except near base and lateral posterior portions of abdominal segments; head minutely punctured, prothorax nearly impunctate, elytra fairly strongly, but not densely punctured, more finely towards apices, ventral surface impunctate.

Head elongate; eyes swollen and moderately prominent, egg-shaped, slightly indented internally; neck constricted immediately behind eyes; occiput with a carina in center; vertex sulcate; antennal tubercles very close, placed slightly behind anterior margin of eyes; frons somewhat squarish, impunctate only in center; labrum twice as broad as long; mandibles long; genæ long and parallel; last segment of maxillary palpi more than twice as long as broad and obliquely truncated apically. Antennæ one-fourth longer than body in male, the segments not expanded at apices; scape short, curved, punctate; second segment longer than broad; third slightly longer and fourth slightly shorter than scape; fifth slightly longer than third; following subequal, the last double the fourth. Prothorax nearly half again as long as broad, constricted before apex; sides obliquely constricted near base; base bisinuate, the angles not dilated. Scutellum narrow, rounded apically. Elytra only slightly longer than head and prothorax united, wedge-shaped, not constricted in middle; apices narrowed internally and obliquely emarginate-truncate, the external angles strongly acuminate. Hind legs fairly long, tibiæ and tarsi compressed, the tarsi not quite as long as the tibiæ; first tarsal segment longer than following united, the second shorter than the remaining. Length, 11.5 to 12.5 millimeters; breadth, 2.6 to 3.

Holotype, male (No. 51013, United States National Museum), and allotopotype female (U. S. Nat. Mus.), and a paratopotype, male, in the author's collection; Sandakan, British North Borneo, Baker collection.

### Genus OCALEMIA Pascoe, 1858

#### OCALEMIA ANGUSTOLINEATA Gressitt sp. nov.

Elongate, strongly narrowed behind; black, sixth to eighth antennal segments (last three missing) largely testaceous, darker at apices and inner sides, each elytron with a minute reddish brown spot on front of humerus and a testaceous discal stripe extending two-thirds of elytral length, broadened near base and very narrow for remainder of its length and gradually becoming closer to, but not touching the suture, remainder of the elytra with a very slight tinge of metallic green, scutellum and ventral surface of body fairly densely clothed with tawny white pubescence; head and pronotum more sparsely clothed, the latter more densely near base; antennæ with a few short black hairs at apices of segments and on underside of basal segments.

Head nearly twice as long as broad, portion anterior to eyes excluding mandibles broader than long, eyes subglobular and greatly swollen, very minutely faceted, slightly indented internally; neck constricted immediately behind eyes; occiput broad; vertex concave in middle and swollen at each side between antennal insertions, which are close and placed near anterior border of eyes; frons longer than broad; labrum nearly as long as broad; last palpal segment subobliquely truncate apically; surface minutely punctulate except on triangular shiny area of frons. Antennæ not quite as long as the body (male), the segments very slightly dilated apically; scape slightly arched; second segment as long as broad; third two-thirds again as long as scape; fourth two-thirds as long as third; fifth nearly as long as third; sixth to eighth subequal and slightly shorter than fifth. Prothorax longer than broad, subcampanulate, constricted before apex; basal margin bisinuate, the external angles hardly produced; surface minutely punctulate. Scutellum triangular, longer than broad. Elytra elongate, strongly narrowed beyond basal third, narrowest in second third except for apex; apex obliquely truncate, produced externally, but not dentate; surface fairly strongly punctate on basal half, less so apically. Abdomen very fine, the first four segments subequal, the last shorter and slightly concave below. Legs with the femora slightly swollen, the hind pair long, the tibiæ at apices and the tarsi laterally compressed, the latter longer than the tibiæ, the first segment longer than the rest combined, and the second longer than the remaining combined. Length, 14 millimeters; breadth, 3.

Holotype, male, a unique (No. 51012, United States National Museum), Lamao, Bataan Province, Luzon, between March and June, 1911, by C. V. Piper.

Similar in structure to *O. prasina* Heller, except that the prothorax is less swollen at sides and the elytra are more narrowed; very different in coloration, the latter being metallic green, with the femora red and only the apical antennal segments pale.

### ATOSSINI

### Genus PARAPHEMONE Gressitt novum

Subcylindrical, parallel-sided; head directed posteriorly below; frons rectangular, nearly half again as high as wide, marked with a median slightly raised line, separated from the clypeus by a transverse swollen ridge; vertex very slightly concave between antennal tubercles, which are almost obsolete; occiput even, marked with a very narrow longitudinal line; clypeus fairly large and strongly narrowed toward apex; labrum two-thirds as long as broad, longer than clypeus; mandibles nearly straight-sided; longitudinally sulcate basally; palpi with the last segment of each pair fusiform and equal in length; genæ very high, each with an oblique transverse costa not reaching frons; eyes very small, lobes separated into two divisions connected by a fine thread, dorsal lobe narrowly oval, ventral lobe shorter than broad, nearly round. Antennæ (female ?) as long as the body, first four segments thick, together as long as the remaining segments, which are very fine; scape cylindrical, reaching to middle of prothorax, noncicatricized; second segment half as long as broad; third segment cylindrical, one-fourth longer than scape; fourth segment two-thirds as long as third, longer than fifth, thickest in middle, narrow at apex, nearly fusiform; fifth and succeeding segments very much finer than preceding ones, successively shorter and finer towards apex. Prothorax barely broader than long, slightly narrowed towards apex, base four-fifths as broad as elytra, posterior margin slightly concave on each side of middle, sides hardly swollen, dorsal surface subvermiculose and punctate at sides. Scutellum broader than long, rounded. Elytra parallel, rounded apically, marked with several feebly swollen costæ which are more noticeable behind middle and interspersed with punctures, which are closer on disc. Ventral surface impunctate; fore coxæ globular and very prominent, but not higher than intercoxal process which is vertical behind and subvertical in front; middle coxal cavities open externally; intercoxal process of mesosternum broad, projecting slightly anteriorly; last abdominal segment longer than the preceding two united, last tergum indented. Legs robust; hind pair much shorter than fore pair, the hind femora reaching barely to middle of abdomen; femora fusiform; middle tibiæ not grooved; tarsi broad, strongly dilated in the first pair, the first segment barely as long as the third, second short; claws narrowly divergent.

*Genotype.—Paraphemone multimaculata* Gressitt.

*Range.*—Lower Siam.

Similar to *Phemone* Pascoe[1] in having the narrow form; elytra which very slightly exceed prothorax in breadth; and the broad anterior tarsi. It is separated, however, by the anomalous condition of the antennæ and the minutely divided eyes. The former have the basal four segments very thick, the fourth thicker than the third, with the remaining segments contrastingly very much finer and also shorter; the scape is shorter and thicker than in *Phemone,* and is as thick near base as at apex. The genus agrees with the tribal characters, except for the frons lacking the longitudinal ridges and the antennal condition being somewhat incongruous.

### PARAPHEMONE MULTIMACULATA Gressitt sp. nov.

Black, clothed with a pile which is white, cinnamon or dark brown in parts; elytra with very many small irregular-shaped white spots arranged rather irregularly in six or seven longitudinal stripes; head with the lower portions, including genæ and apical two-thirds of frons dirty whitish cinnamon, the labrum darker, upper portions of head dark gray-brown with the exception of two longitudinal stripes of cinnamon at each side, one pair commencing on vertex between antennal insertions and becoming farther apart posteriorly, the other pair commencing behind antennal insertions; antennæ with the first three segments cinnamon, the fourth, except base, dark brown, the fifth and sixth dirty cinnamon basally with their apices and the remaining segments dull chestnut; prothorax grayish brown, nearly black, with a pair of longitudinal parallel cinnamon stripes at each side of dorsal surface, being the continuations

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[1] Trans. Ent. Soc. London II 5 (1858-1861) 48, pl. 2, fig. 5.

of the cephalic stripes, portion below middle of sides clothed with dense white hairs; sides of meso- and metathorax and abdomen, except for a marginal triangle on each abdominal segment, similarly clothed with white; a fringe of longer hairs at apex and margin of abdomen; forelegs dirty cinnamon, the middle and hind pairs paler.

Head narrow, impunctate; frons high and parallel-sided; labrum large; eyes very small; antennæ as long as the body, the scape reaching to middle of prothorax, nearly as long as third; fourth two-thirds as long, remaining segments much shorter and finer; prothorax broader than long, cylindrical; disc not swollen, slightly transversely vermiculose, punctate laterally; scutellum short, rounded; elytra moderately well punctured, with about four low ridges extending posteriorly slightly obliquely towards suture, apices rounded externally; ventral surface impunctate; prosternal intercoxal process as high as coxæ, which are very prominent, mesosternal process broad and directed slightly anteriorly, metasternum glabrous; forelegs longer and hind legs shorter than middle pair, hind femora as long as first three abdominal segments; fore tarsi very broad. Length, 13.25 millimeters; breadth, 4.25.

Holotype, female (?), a unique (No. 50902, United States National Museum); Trong, Lower Siam, W. L. Abbott.

# A REVIEW OF PHILIPPINE MENIDÆ AND GERRIDÆ

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THREE PLATES

This paper contains a review of the families Menidæ and Gerridæ known to inhabit Philippine waters. The material used is in the collection of the fish and game administration, Bureau of Science, Manila.

## MENIDÆ

Body strongly compressed, nearly triangular, with prominent, trenchant abdomen, covered with minute scales, not visible to the naked eye. Head small, mouth vertical and protractile; teeth villiform, none on palate. Preoperculum and operculum entire. Dorsal single, long, without distinct spinous portion; anal without spines, and with rays enveloped by skin, their free extremities very broad; ventral thoracic, with one spine and five soft rays, first ray very elongate. Branchiostegals seven.

This family is represented in the Philippines by one genus and one species.

Menidæ is closest to Lamprididæ, known as opah, moonfish, mariposa, or San Pedro fish. *Mene maculata* is a small fish, about a foot long, with compressed body. The fins are low and the belly, through the extension of the pelvic bone, is more prominent than the back. The ventral fins have one spine and five soft rays, a character which separates *Mene* widely from *Lampris,* which is allied to it.

**MENE MACULATA (Bloch and Schneider). Plate 1, fig. 1.**

*Zeus maculatus* BLOCH and SCHNEIDER, Syst. Ichth. (1801) 95.

*Mene anna carolina* LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 479–480.

*Mene maculata* CUVIER and VALENCIENNES, Hist. Nat. Poiss. 10 (1835) 104; GÜNTHER, Cat. Brit. Mus. 2 (1860) 415; DAY, Fishes of India 4.° (1878–1888) 249; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 [(1906) 1907] 15; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 251; MCCULLOCH, Mem. Queensl. Mus. 7 (1922) 241; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 6 (1931) 308–309.

Dorsal IV, 40–42; anal 30–33; pectoral 15; ventral I, 5.

Depth 1.3; head 4; eye 3.33 in head; snout 1.66 in head. Body ovoid, deepest anteriorly. Upper profile nearly horizontal, lower nearly semicircular. Mouth vertical; intermaxillaries protractile, extending upwards when protruded; lower jaw slightly the longer; when protracted forming a tube directed horizontally, cleft twice as long as gape. Anterior portion of upper jaw formed by premaxillaries, the maxilla smooth, somewhat S-shaped and extending to below anterior edge of orbit. Preoperculum and operculum rounded and entire. Occipital crest high. Seven branchiostegals; gill opening wide, gill membranes not connected, free from isthmus. Teeth in villiform rows on jaws, none on palate. Dorsal fin highest anteriorly, anterior rays undivided and slightly more elevated than the remainder. Pectoral as long as head, excluding snout, rays flat; ventral spine short, its first ray compressed and very long. Anal rudimentary, its rays forming short, wide, and flat processes. Caudal deeply incised, with equal lobes. Lateral line terminates below end of dorsal fin. Color deep blue along back, becoming silvery white on sides and abdomen; from two to four irregular series of lead-colored rounded spots above and below lateral line; fins hyaline, dorsal, caudal, and ventral filaments dusky.

Small fish, at most a foot long, inhabiting shallow sandy places.

*Habitat.*—Sea of Penang, Singapore, Sumatra, Java, Celebes, Madagascar, British India, Ceylon, China, Japan, Formosa, Philippines, and Queensland.

The above description is based on No. 12478, 152 mm, from Rabon, La Union, July 24, 1925.

LUZON, Ilocos Sur Province, Vigan, No. 10210, 172 mm, February, 1923: Manila, No. 6756, 120 mm, September 15, 1911. SAMAR, Samar Province, Calbayog, Nos. 14870, 28195, 160 to 180 mm: NEGROS, Occidental Negros Province, Cadiz, Nos. 16248, 28196, 146 to 156 mm. MINDANAO, Agusan Province, Butuan Bay, No. 1907, 161 mm, September 25, 1907.

## GERRIDÆ

Body compressed, back more or less elevated, form usually ovoid. Scales moderate, minutely ciliated or crenulated, present on occipital, frontal, and lateral parts of head. Lateral line complete and continuous, concurrent with profile of back. No ridges on top of head; an interorbital with a naked concavity for receiving maxillary process. Eyes rather large, lateral.

Mouth moderate, greatly protractile, extending downward when protruded. Maxillary without supplemental bone and not slipping below a very narrow preorbital; a slit between base of mandible and preorbital permits the free motion of maxillary. Teeth small, acute, none on vomer, palatines, or tongue. Six branchiostegals; four gills; pseudobranchiæ present, glandular; gill membranes free, not united at isthmus. Lower pharyngeal bones united by mobile suture or ligament, forming a more or less triangular osseous plate, covered with conical or subulate teeth. Dorsals and anals depressible into basal scaly sheaths. Dorsal fin single, continuous or deeply notched. Dorsal spines usually nine, sometimes ten. Anal with three spines and seven rays. Ventrals thoracic, with one spine and five rays, the fins rather close together and slightly behind pectorals. Pectorals long, pointed. Caudal deeply incised with fifteen branched rays.

Small or medium-sized fishes of the tropical and temperate seas, some entering mouths of rivers. More or less bright to brilliant silvery white; some may be marked with slightly darker longitudinal or transverse lines, bands, or blotches.

Found frequently in great numbers about sandy shallows, where they are said to spawn and feed. Most of the species are valued as food fishes.

This family is represented by one genus with seven species in the collection. *Gerres poeti* Cuvier and Valenciennes was reported by Fowler as being present in Philippine waters, but it has no example in our collection.

The taxonomic position of the family Gerridæ in relation to Leiognathidæ has been the subject of varying opinions. Bleeker treated *Equula* (*Leiognathus*) and *Gazza* under the Carangidæ and gave *Gerres* and *Pentaprion* as subfamily Gerriformes a place in what he named "Percoidei." Günther[1] placed the family Gerridæ in the "Acanthopterygii Pharyngognathi," and united *Equula* and *Gazza* with the Carangidæ, because the lower pharyngeal bones are firmly united by a suture. Jordan in his latest classification of fishes (1923) writes: "The resemblance of *Leiognathus* to *Gerres* seems to be superficial not indicating any special affinity." The author agrees with Jordan and, therefore, disagrees with Weber and de Beaufort[2] that Leiognathidæ should be separated from Gerridæ.

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[1] Cat. Brit. Mus. 4 (1862) 252.

[2] The Fishes of the Indo-Australian Archipelago 6 (1931) 310.

### *Key to the Philippine species of Gerres.*

*a*$^1$. Pectoral reaches opposite or beyond anal origin.

- *b*$^1$. Distance of dorsal origin from end of snout equal to height of body.
  - *c*$^1$. Scales in lateral series 32 to 36; in transverse series 15; scales 5 to 7 from lateral line to dorsal origin; second dorsal spine 1.1 to 1.2 in head; depth of body 1.9 to 2.1. *Gerres abbreviatus* Bleeker.
  - *c*$^2$. Scales in lateral series 40 to 45; in transverse series 18 to 20; scales 5 or 6 from lateral line to dorsal origin; second dorsal spine very much longer than head; depth of body 2.2 to 2.5. *Gerres filamentosus* Cuvier.
- *b*$^2$. Distance of dorsal origin from end of snout greater than height.
  - *c*$^1$. Scales in lateral series 36 to 40; second dorsal spine 1.3 to 1.7 in head.
    - *d*$^1$. Transverse series 15; scales 4 or 5 from lateral line to dorsal origin; depth of body 2.5 to 3................ *Gerres kapas* Bleeker.
    - *d*$^2$. Transverse series 16; scales 5 to 7 from lateral line to dorsal origin; depth of body 2.5 to 2.8............ *Gerres oyena* (Forskål).
  - *c*$^2$. Scales in lateral series 45 to 48; transverse series 17; scales 7 from lateral line to spinous dorsal origin; second dorsal spine 1.5 to 2 in head; depth of body 3.1. *Gerres oblongus* Cuvier and Valenciennes.

*a*$^2$. Pectoral not reaching anal origin.

- *b*$^1$. Scales in lateral series 40 to 42; transverse series 14 or 15; scales 5 from lateral line to dorsal origin; second dorsal spine 1.3 to 1.5 in head; depth 2.5; premaxillary groove completely scaled in front. *Gerres baconensis* (Evermann and Seale).
- *b*$^2$. Scales in lateral series 42 or 43; transverse series 17 or 18; scales 4.5 or 5 from lateral line to dorsal origin; second dorsal spine 1.5 to 1.7 in head; depth 3 to 3.1........ *Gerres macrosoma* Bleeker.

**GERRES ABBREVIATUS Bleeker.** Plate 1, fig. 2.

*Gerres abbreviatus* Bleeker, Nat. Tijdschr. Ned. Ind. 1 (1850) 103; Günther, Cat. Fish. Brit. Mus. 1 (1859) 345; Kner, Reise Novara, Fische (1865) 56; Day, Proc. Zool. Soc. London (1870) 698; Fish. Ind. 4°. (1878–88) 99; Meyer, Anal. Soc. Española Hist. Nat., Madrid 14 (1885) 18; Day, Fauna Brit. India, Fishes 2 (1889) 538; Weber, Siboga-Exp. 57 (1913) 272; Fowler, Proc. Acad. Nat. Sci. Phila. (1927) 284; Fowler and Bean, Proc. U. S. Nat. Mus. 71 Art. 10 (1927) 7; Fowler, Mem. B. P. Bishop Mus. 10 (1928) 224.

*Diapterus abbreviatus* Bleeker, Atlas Ichth. Ind. Neerland. 8 (1876–77) 127, pl. (78), fig. 4.

*Xystaema abbreviatum* Jordan and Seale, Bull. Bur. Fish. 25 [(1905) 1906] 272; Jordan and Richardson, Mem. Carnegie Mus. 4 (1909) 190.

*Xystaema abbreviatus* Seale, Philip. Journ. Sci. § D 5 (1910) 278.

*Xystaema abbreviata* Fowler, Copeia No. 58 (1918) 64.

Dorsal IX, 10; anal III, 7; scales in lateral line 32 to 36; transverse series 15.

Body oblong, anteriorly elevated, the dorsal profile ascending to about 45° from snout to dorsal fin, thence descending nearly straight to caudal peduncle. Height about 2 in length, head 3 to 3.10, pointed; interorbital 2.5 to 3, broadly convex to nearly level, is lightly smaller than eye, whose diameter is 2.7 to 3 in head and is longer than snout. Maxillary reaches opposite pupil; mandibular profile slightly concave. Lower pharyngeal bones coössified with a double median series of large molariform teeth in pavementlike arrangement. Preoperculum entire. Scales large, thin, with margin entire; three rows on cheek to preopercle ridge. Scales with five or six basal radiating striæ; circuli very fine. Dorsal origin to end of snout nearly equal to height of body; second dorsal spine 1.1 to 1.2 in head, first ray 2.1 to 2.5. Second anal spine 1.7 to 2, first ray 1.9 to 2.25, least depth of caudal peduncle 2.2 to 2.3, ventral 1.2 to 1.3; caudal 2 to 3.5 in body; pectorals much longer than head, 2.3 to 2.7 in body. Body silvery, bluish above with indistinct longitudinal darkish lines corresponding with the series of lateral scales. Fins pale, dorsal dusky gray terminally.

*Habitat.*—Queensland, India, East Indies, and Philippine Islands.

The above description is based on No. 15502, 190 mm, Guinlo, Palawan, June 1, 1927.

LUZON, Zambales Province, Subic, No. 15119, 177 mm, April 9, 1927: Manila, Manila Market, No. 165, 126 mm, June 14, 1907; No. 553, 26 to 33 mm, August, 1907: Batangas Province, Balayan Bay, Lemery, Nos. 24111, 13890, 24112, 4579, 80 to 97 mm, April 19, 1926: Tayabas Province, Polillo, No. 31251, 68 mm, April 5, 1928. MINDORO, Mindoro Province, Mangarin, No. 9649, 158 mm, 1913. ROMBLON, Romblon Province, Romblon, Nos. 11878, 24080, 65 to 93 mm, August 1, 1921. MASBATE, Masbate Province, Aroroy, Nos. 27634, 27636, 1059, 40 to 52 mm, August 30, 1907, Guinobatan, No. 1081, 47 mm, August 31, 1907. LEYTE, Leyte Province, Carigara, Nos. 14986, 14649, 24109, 24110, 74 to 84 mm, December 1, 1926. SAMAR, Samar Province, Calbayog, No. 14656, 170 mm, December 17, 1926. SIQUIJOR, Oriental Negros Province, Lazi, No. 5299, 40 to 58 mm, September 6, 1909. PALAWAN, Palawan Province, Puerto Princesa, No. 1963, 86 mm, September 30, 1907; Puerto Princesa No. 12438, 141 mm, September 12, 1905; Panacan, Paragna, Nos. 5333, 27633, 45 to 59 mm, August 14, 1908; Canigaran, Nos. 24084, 24085, 12643, 51 to 95 mm, November, 1925. BALA-

BAC, Palawan Province, Balabac, No. 15773, 202 mm, November 17, 1926; No. 5113, 43 mm, August 6, 1908. MINDANAO, Cagayan Province, Cagayan, No. 1464, 91 mm, September 8, 1907; No. 1494, 45 mm, September 9, 1907; No. 1643, 55 mm, May 13, 1907: Zamboanga Province, Nos. 2949, 27635, 52 to 58 mm, April 10, 1908. SAMAL, Davao Province, No. 3507, 55 mm, April 29, 1908. TAWITAWI, Sulu Province, Buan, No. 10769, 240 mm, September 21, 1923; Nos. 24086, 24087, 11843, 67 to 79 mm, August 18, 1924. BILATAN, Sulu Province, No. 11354, 169 mm, July 29, 1924. BUNGAU, Sulu Province, No. 11923, 52 mm, September, 1923.

We have the following foreign example: BORNEO, Sandakan, No. 14143, 118 mm, November, 1925.

**GERRES FILAMENTOSUS Cuvier. Plate 2, fig. 1.**

*Gerres filamentosus* CUVIER, Regne Animal ed. 1 7 [1816 (1817)] 104; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 6 (1830) 363; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 345; KNER, Reise Novara, Fische (1865) 56; DAY, Fishes of Malabar (1865) 159; PETERS, Monatsb. Akad. Wiss. Berlin (1868) 257; DAY, Proc. Zool. Soc. London (1870) 698; Fishes of India pt. 1 (1875) 98, pl. 25, fig. 3; PETERS, Monatsb. Akad. Wiss. Berlin (1876) 437; DAY, Fauna Brit. India, Fishes 2 (1889) 537, fig. 163; FOWLER, Journ. Acad. Nat. Sci. Phila. II 12 (1904) 530; SNYDER, Proc. U. S. Nat. Mus. 42 (1912) 501; WEBER, Siboga-Exp. 57 (1913) 271; DE BEAUFORT, Bijd. Dierk. Amsterdam 19 (1913) 120; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 Art. 2 (1922) 42; FOWLER, Proc. Acad. Nat. Sci. Phila. (1923) 41; (1925) 244; Journ. Bombay Nat. Hist. Soc. 3 No. 4 (1926) 8; FOWLER and BEAN, Proc. U. S. Nat. Mus. 71 Art. 10 (1927) 7; FOWLER, Proc. Acad. Nat. Sci. Phila. (1927) 285; Journ. Bombay Nat. Hist. Soc. 33 No. 1 (1928) 115; Mem. B. P. Bishop Mus. 10 (1928) 226; Proc. Acad. Nat. Sci. Phila. [1929 (1930)] 610; FOWLER, Mem. B. P. Bishop Mus. 11 No. 5 (1931) 336.

*Catochaenum filamentosus* CANTOR, Journ. Asiat. Soc. Bengal 18 pt. 2 (1850) 1038, 1849.

*Diapterus filamentosus* BLEEKER, Ned. Tijdschr. Dierk. 4 (1873) 117; Atlas Ichth. Ind. Neerland. 8 (1876–77) 124, pl. 78, fig. 3.

*Gerres punctatus* CUVIER and VALENCIENNES, Hist. Nat. Poiss. 6 (1830) 480; BLEEKER, Natuur. Geneesk. Arch. Ned. Ind. 2 (1845) 521; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 345; DAY, Fishes of Malabar (1865) 159; SAUVAGE, Hist. Nat. Madagascar, Poiss. (1891) 246; CASTO DE ELERA, Cat. Fauna Filip. 1 (1895) 560.

*Xystaema punctatum* JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 782; Bull. U. S. Bur. Fish. 26 [1906 (1907)] 24; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 244; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 69; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 [1907 (1908)] 260; SEALE, Philip.

Journ. Sci. § D **9** (1914) 67; JORDAN and STARKS, Ann. Carnegie Mus. **11** Nos. 3, 4 (1917) 455; FOWLER, Copeia No. **58** (1918) 64.

*Gerres macracanthus* BLEEKER, Tijdschr. Neder. Ind. **6** (1854) 195; GÜNTHER, Cat. Fish. Brit. Mus. **4** (1862) 261; DE BEAUFORT, Bijd. Dierk., Amsterdam **19** (1913) 121.

*Diapterus macracanthus* BLEEKER, Atlas Ichth. Ind. Neerland. **8** (1876–77) 125, pl. (78) 362, fig. 1.

*Sparus edentulus* GÜNTHER, Cat. Fish. Brit. Mus. **1** (1859) 346.

*Xystaema macracantha* FOWLER, Copeia No. **58** (1918) 64.

*Gerres philippinus* GÜNTHER, Cat. Fish. Brit. Mus. **4** (1862) 258; Ann. & Mag. Nat. Hist. III **20** (1867) 66; CASTO DE ELERA, Cat. Fauna Filip. **1** (1895) 560.

*Diapterus philippinus* BLEEKER, Versl. Meded. Akad. Wet. Amsterdam II **7** (1873) 242.

Dorsal IX, 10; anal III, 7; scales in lateral line 40; transverse series 18 or 19.

Body oblong, elevated, height 2.2 to 2.5; head pointed, 3 to 3.5. Snout 3 to 3.4 in head; eye 3, about equal to snout, 1 to 1.3 in interorbital space, somewhat more than pointed snout. Mandibular profile strongly concave. Maxillary surpasses front edge of eye. Interorbital 2.5 to 3, broadly convex. Gill rakers 4 + 7, lanceolate, a third of gill filaments, which is 2.5 in eye.

Scales 40 to 45 in lateral line to caudal base, and 3 to 5 more beyond; 20 to 22 predorsals, forward opposite front eye edge; three rows on cheek to preopercular ridge. Scales with six to ten basal radiating striæ; circuli extremely fine. Dorsal fin originates at a distance from end of snout which nearly equals height of body and its entire length. Second dorsal spine strong and produced into a filament, about as long as body. Third spine 1.3 to 1.7 in head. Third spine of anal 2.3 to 2.5; first ray 2.3 to 2.7. Caudal forked; least depth of caudal peduncle 2.5 to 2.8; ventral 1.3; pectoral 1.5 to 2.3 in length of body.

Back pale brown, with ten to twelve pale dusky vertical lines, often broken as a series of dark blotches. Snout edge and upper lip dusky. Row of dark spots on soft dorsal, one on each membrane below middle and concealed by basal sheaths.

*Habitat.*—China, Queensland, Melanesia, Indo-China, East Indies, Penang, Ceylon, Red Sea, Portuguese East Africa, Madagascar, and Philippines.

The above description is based on No. 15152, 152 mm, from Lake Bombon, Batangas, March 23 to April 8, 1927.

LUZON, Ilocos Sur Province, Vigan, No. 11977, 62 mm, January 3, 1923: Pangasinan Province, Agno River, Nos. 676, 677, 65 to 84 mm, July 18, 1907; Bulacan Province, Santa Cruz, Paombong, No. 24066, 115 mm, April 27, 1927: Rizal Province, Malabon, No. 747, 86 mm, July 18, 1907: Pampanga Province, Lubao, No. 15996, 123 mm, April 30, 1927; Macabebe, Pilipit, No. 15323, 61 mm, May 7, 1927: Zambales Province, Iba, No. 11952, 95 mm, October 26, 1921; Subic Bay, No. 15144, 165 mm, April 19, 1927: Manila, Manila Bay near Limay, Nos. 15655, 24069, 101 to 102 mm, November 18, 1927; Manila, No. 112, 98 mm, June 1, 1907; No. 958, 143 mm, September 1907; No. 272, 120 mm, June 14, 1907: Batangas Province, Batangas, No. 2219, 67 mm, January 16, 1908; Limbones, Nos. 24076, 2205, 24077, 35 to 38 mm, January 14, 1908; Pancipit, San Nicolas, No. 12966, 55 mm, January 9, 1926; No. 15152, 104 mm, April 8, 1927; Nasugbu, Barrio Papaya, No. 13051, 65 mm, January 3, 1926: Albay Province, Legaspi, Yawa River, Nos. 1331, 13380, 24113, 24115, 24114, 34 to 76 mm, February 7, 1926: Camarines Sur Province, San Miguel Bay, Nos. 24079, 11888, 73 to 88 mm, February and March, 1922: Sorsogon Province, Bulan, No. 3221, 112 mm, 1904. MINDORO, Mindoro Province, Naujan, Butas River, Nos. 15257, 24071, 15432, 64 to 103 mm, August 10, 1927; Mangarin, Nos. 24072, 9605, 24070, 68 to 172 mm, 1913. NEGROS, Negros Oriental Province, Zamboanguita, No. 2408, 89 mm, March 13, 1922. SAMAR, Samar Province, Catbalogan, No. 1239, 68 mm, September 4, 1907; Basey, San Pedro Bay, No. 12355, 73 mm, September 17, 1925. PANAY, Iloilo Province, Dumangas, No. 9959, 103 mm, June 2, 1922; Iloilo, No. 10051, 102 mm, May 1922: Capiz Province, New Washington, No. 12725, 77 mm, August 6, 1925: Antique Province, San Jose, Nos. 24090, 24091, 24092, 13147, 57 to 79 mm, February 1926. GUIMARAS, Iloilo Province, Guimaras, No. 41335, 98 mm, December 18, 1933. PALAWAN, Palawan Province, Tagbanua, Nos. 15496, 24074, 78 to 100 mm, June 1, 1927. CULION, Palawan Province, Culion, Nos. 6189, 6210, 6188, 32 to 85 mm, October, 1910. PALAWAN, Palawan Province, Puerto Princesa, No. 1971, 59 mm, 1910. MINDANAO, Agusan Province, Agusan River, No. 1477, 68 mm, September 8, 1907: Zamboanga Province Zamboanga, Nos. 24078, 2971, 110 to 113 mm, April 13, 1908; No. 2903, 48 mm, April 10, 1908, Nos. 4459, 4460, 90 to 95 mm, June 16, 1908: Davao Province, Davao, No. 3127, 65 mm, April 20, 1908; No. 24138, 88 mm, April 23, 1908; No. 3385, 55 mm, April 24, 1908; Nos. 3294, 24075, 35 to 73 mm, April 23, 1908; No. 3404, 70 mm, April 25, 1908: Surigao Province, Gigaket, Nos. 27629, 9985, 100 to 110 mm, June 5, 1922.

We have the following foreign examples: CHINA, Hongkong, No. 6564, 88 mm; No. 6572, 55 mm, August, 1910; Hoichow, Hainan, No. 27631, 79 mm; No. 27632, 66 mm, No. 27630, 73 mm; No. 10104, 75 mm, 1922. BORNEO, Sandakan, No. 2451, 67 mm, No. 2564, 65 mm; No. 2588, 70 mm, February, 1908.

**GERRES KAPAS Bleeker. Plate 2, fig. 2.**

*Gerres kapas* BLEEKER, Nat. Tijdschr. Ned. Ind. 2 (1851) 482; 3 (1852) 161; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 352; CASTO DE ELERA, Cat. Fauna de Filipinas 1 (1895) 477; WEBER, Siboga-Exp. 65 (1913) 271; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 art. 2 (1922) 41; FOWLER, Proc. Acad. Nat. Sci. Phila. (1927) 284; Mem. B. P. Bishop. Mus. 10 (1928) 225; Proc. Acad. Nat. Sci. Phila. [1929 (1930)] 647.

*Diapterus kapas* BLEEKER, Atlas Ichth. Ind. Neerland. 8 (1876–77) 127, pl. (77) 361, fig. 3.

*Xystaema kapas* EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 70; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 244; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 260; SEALE, Philip. Journ. Sci. § D 5 (1910) 278.

*Xystaema baconensis* (part) EVERMANN and SEALE, Bull. Bur. U. S. Fish. 26 (1906) 70; FOWLER, Copeia No. 58 (1918) 64; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 6 (1931) 348–349.

Dorsal IX, 10; anal III, 7; scales in lateral line 40; transverse series 15.

Body oblong, dorsal profile elevated and compressed at origin of dorsal. Depth 2.5 to 3; head 3 to 3.2; snout 3 to 3.3 in head; eye about 3 to 3.5 in head. Maxillary reaches to below anterior third of eye; mandibular profile slightly concave; teeth fine, villiform, in bands in jaws; gill rakers 5 + 8, lanceolate, about 0.25 to 0.5 of gill filaments or 3 to 4 in eye; upper three rudimentary. Preoperculum entire, with rounded angle. Scales more or less crenulate. Distance of dorsal origin from end of snout greater than height of body and less than length of dorsal; 18 to 20 predorsal scales, forward opposite front of eye edge; premaxillary groove broadly naked; three rows of scales on cheek to preopercular ridge. Scales with six to eight basal radiating striæ; fine circuli very largely parallel and vertical. Second spine of dorsal 1.3 to 1.7 in head, first ray 2.8 to 3; least depth of caudal peduncle 2.3 to 2.7; ventral 1.7; pectoral 3 to 3.3 in combined head and trunk to caudal base.

Color silvery, tip of spinous dorsal black; body without longitudinal darker lines.

*Habitat.*—East Indies, Siam, Polynesia, east coast of Africa, and Philippines.

The above description is based on No. 3418, 129 mm, Bacon, Sorsogon, 1904.

LUZON, La Union Province, Camp Wallace, San Fernando, No. 907, 75 mm, August, 1907: Batangas Province, Limbones Cove, No. 2204, 38 to 52 mm, January 14, 1908. BOHOL, Bohol Province, Inabanga, Nos. 14692, 24083 76 to 115 mm, December 3, 1926. CUYO, Palawan Province, Cuyo, No. 2049, 67 mm, October 1, 1907. MINDANAO, Surigao Province, Placer, No. 1789, 48 mm, September 17, 1907. SAMAL, Davao Province, Samal, No. 3901, 47 mm, May 4, 1908. SITANKAI, Sulu Province, Sitankai, No. 4546, 89 mm, June 20, 1908; No. 4579, 78 mm, July 2, 1908.

We have the following foreign examples: GUAM, No. 7001, 72 mm; No. 7003, 7 mm, No. 7004, 76 mm, No. 6999, 81 mm, No. 6997, 63 mm; No. 7005, 83 mm; No. 6998, 61 mm; No. 7000, 87 mm; No. 7002, 127 mm; No. 7006, 83 mm; No. 7007, 61 mm, September, 1911. BORNEO, Sandakan, No. 2537, 66 mm, February, 1908.

**GERRES OYENA (Forskål). Plate 2, fig. 3.**

*Labrus oyena* FORSKÅL, Descript. Animal. (1775) 35; BLOCH, Schneider, Syst. Ichth. (1801) 245.

*Smaris oyena* RÜPPELL, Atl. Reise Nördl. Afrika, Fische (1828) 11.

*Gerres oyena* CUVIER and VALENCIENNES, Hist. Nat. Poiss. 6 (1830) 472; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 353; 4 (1862) 261; PLAYFAIR, Fishes of Zanzibar (1866) 111; DAY, Fishes of India 4°. (1878–88) 99; MACLEAY, Descr. Cat. Austral. Fish. 1 (1881) 78; MEYER, Anal. Soc. Española Hist. Nat. Madrid 14 (1885) 18; DAY, Fauna Brit. India 2 (1889) 538; SAUVAGE, Hist. Nat. Madagascar, Poiss. (1891) 243, pl. 36A, fig. 2; CASTO DE ELERA, Cat. Fauna Filip. 1 (1895) 560; WEBER, Siboga-Exp. 57 (1913) 273; FOWLER, Mem. B. P. Bishop. Mus. 10 (1928) 225; Proc. Acad. Nat. Sci. Phila. (1931) 247.

*Diapterus oyena* BLEEKER, Atlas Ichth. Ind. Neerland. 8 (1876–77) 129.

*Xystaema oyena* SMITH and POPE, Proc. U. S. Nat. Mus. 31 (1906) 478; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1908) 244; SEALE, Philip. Journ. Sci. § D 5 (1910) 278; FOWLER, Copeia No. 58 (1918) 64.

*Xystaema erythrourum* JORDAN, Proc. U. S. Nat. Mus. 32 (1907) 246, fig. 1; SNYDER, Proc. U. S. Nat. Mus. 42 (1912) 416; FOWLER, Proc. Acad. Nat. Sci. Phila. (1929) 647.

*Gerres erythrourus* JORDAN and HUBBS, Mem. Carnegie Mus. 10 No. 2 (1925) 242.

*Gerres oblongus* BLEEKER, Natuur. Geneesk. Arch. Ned. Ind. 2 (1845) 521.

*Gerres acinaces* BLEEKER, Nat. Tijdschr. Ned. 6 (1854) 194; GÜNTHER, Cat. Fish. Brit. Mus. 1 (1859) 351; DAY, Proc. Zool. Soc. London (1870) 698; SAUVAGE, Hist. Nat. Madagascar, Poiss. (1891) 245; FOWLER, Proc. Acad. Nat. Sci. Phila. (1925) 245; Mem. B. P. Bishop. Mus. 10 (1928) 224.

*Diapterus acinaces* BLEEKER, Atlas Ichth. Ind. Neerland. 8 (1876–77) 126 pl. (77) 361, fig. 2.

*Diapterus filamentosus* BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 231.

*Gerres lineolatus* PLAYFAIR, Fishes of Zanzibar (1866) 110, pl. 16, fig. 2.

*Gerres splendens* WHITLEY, Mem. Queensland Mus. 10 (1930) 15, pl. 1, fig. 1.

Dorsal IX, 10; anal III, 7; scales in lateral line 36 to 38; transverse series 15 to 17.

Body oblong, rostrodorsal profile rounded; height 2.5 to 2.8; head 3 to 3.3; eye 3 to 3.3 in head, equal to or somewhat less than interorbital space, which is scaleless, in its middle; snout about equal to eye or shorter. Maxillary reaching slightly behind front border of eye; mandibular profile slightly concave. Gill rakers 6 + 7, short points, 2.3 in gill filaments, which is 0.5 of eye. Scales thin, deciduous, with seven to nine basal radiating striæ and as many as six incomplete auxiliaries; circuli very fine; twenty-two to twenty-four predorsal scales forward nearly to nostrils leaving broad scaleless premaxillary groove in front of interorbital; three or four rows on cheek to preopercular ridge. Preoperculum entire, its angle rounded. Lower pharyngeal bones united by a mobile suture, covered by conical or tubulate small teeth, becoming somewhat longer towards median line. Distance from end of snout to origin of dorsal greater than height of body, but less than length of dorsal. Second dorsal spine 1.3 to 1.7 in head, 2 to 2.8 in depth, first ray 2.5 to 2.8; caudal widely forked; least depth of caudal peduncle 2.9 to 3; ventral 1.3 to 1.6; pectoral 3 to 3.3 in length. Color silvery, darker above; spinous dorsal with a blackish margin. Each membrane of dorsal basally with brown spot partly concealed by basal scaly sheath of fin. Slightly dusky at base of anal.

*Habitat.*—Singapore, Sumatra, Java, Borneo, Celebes, Red Sea, Zanzibar, Mauritius, Madagascar, British India, Japan, Australia, Caroline Islands, Guam, and the Philippine Islands.

SAMAR, Samar Province, Catbalogan, No. 1110, 54 mm, September 2, 1907. BANTAYAN, Cebu Province, Bantayan, Nos. 5928, 5934, 5936, 5939, 5942, 3943, 24073, 28 to 30 mm, May,

1909. PANAY, Iloilo Province, Estancia, Nos. 24108, 11841, 73 to 85 mm, February 11, 1925. CUYO, Palawan Province, Cuyo, No. 1993, 107 mm, October 1, 1907. PALAWAN, Palawan Province, Puerto Princesa, No. 5398, 45 to 47 mm, August 19, 1908. MINDANAO, Cagayan Province, Cagayan, No. 1584, 122 mm, September 12, 1907; No. 1668, 118 mm, September 13, 1907: Zamboanga Province, Zamboanga, No. 4440, 123 mm, June 15, 1908; Caldera Bay, No. 4043, 49 to 54 mm, May 20, 1908. BILATAN, Sulu Province, Bilatan, No. 11353, 204 mm, July 29, 1924. SITANKAI, Sulu Province, Sitankai, No. 4849, 102 mm, July 17, 1908; No. 4585, 68 mm, July 3, 1916; Tubigan, No. 13787, 62 mm, March, 1926.

We have the following foreign example: BORNEO, Sandakan, No. 2609, 85 mm, February, 1908.

### GERRES OBLONGUS Cuvier and Valenciennes. Plate 3, fig. 1.

*Gerres oblongus* CUVIER and VALENCIENNES, Hist. Nat. Poiss **6** (1830) 361; GÜNTHER, Cat. Fish. Brit. Mus. **1** (1859) 354; **4** (1862) 264; DAY, Fishes of India **1** (1878) 98, pl. 25, fig. 2; Fauna Brit. India **1** (1889) 536; Siboga-Exp. **65** (1913) 272; FOWLER, Proc. Acad. Nat. Sci. Phila. (1925) 244.

*Gerres gigas* GÜNTHER, Cat. Fish. Brit. Mus. **4** (1862) 262; Journ. Mus. Godeffroy **2** and **3** (1874) 30, pls. 5, 6, 24, fig. A; FOWLER, Mem. B. P. Bishop Mus. **10** (1928) 226.

*Gerres macrosoma* KNER, Sitzungsber. Akad. Wiss. Wien. **58** (1868) 301.

*Gerres carinatus* ALLEYNE and MACLEAY, Proc. Linn. Soc. New South Wales **1** (1876) 273, pl. 7, fig. 4.

*Gerres oblongus* DAY, Fishes of India 4°. (1878–1888) 98.

Dorsal IX, 10; anal III, 7; scales in lateral line 45 to 48; transverse series 17.

Body oblong, height 3 to 3.1 in length, about equal to length of head, which is pointed. Head 3.2; eye 3.3, equal to snout and naked interorbital space. Maxillary reaching to below front border of eye, length 2.8 to 3 in head; profile of mandibula slightly concave. Interorbital 3.5 to 3.7 broad, and little convex. Gill rakers 4 + 8, short points, 0.5 of gill filaments, which is 4.4 in eye. Preoperculum entire and rounded. Distance of dorsal origin to end of snout much less than length of entire dorsal and more than 0.2 longer than height of body; twenty-two to twenty-five predorsal scales extending anteriorly to opposite front eye edge, premaxillary groove broad, naked; three rows of scales on cheek to preopercle ridge. Scales with five basal radiating striæ; basal circuli are fine parallel transverse striæ. Second dorsal spine rather strong and elongate, 1.5 to 2 in head, first ray 3 to 3.3. Second anal spine the strongest, nearly 3 in head, first ray 3; least depth of caudal peduncle 3.7 to 4; pectoral equal head, longer in young; ventral 1.8; caudal 1 to 1.1, deeply forked. Back pale brown, with purplish shades. Sides and lower parts white with silvery white shades. Fins all pale, membranes of spinous dorsal dusky at end and each membrane with dusky spot basally, mostly concealed by basal scaly sheath.

*Habitat.*—New Guinea, Portuguese East Africa, India, Ceylon, Andamans, East Indies, Queensland, Polynesia, and Philippines.

The above description is based on No. 11437, 128 mm, Calapan, Mindoro, January 17, 1923.

LUMBUCAN, Palawan Province, Nos. 24095, 24097, 61 to 83 mm, January 17, 1923; Nos. 24093, 24101, 24096, 24102, 24100, 15671, 24098, 24094, 24099, 12596, 24117, 52 to 188 mm, November 14 to 29, 1927. CUYO, Palawan Province, Cuyo, No. 2047, 56 mm, October 1, 1907. MINDANAO, Zamboanga Province, Zamboanga, Nos. 4325, 4326, 24068, 24067, 41 to 77 mm, June 3, 1908. SAMAL, Davao Province, Samal Island, No. 3731, 33 mm, May 1, 1908.

### GERRES BACONENSIS (Evermann and Seale). Plate 3, fig. 2.

*Xystaema baconensis* EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 [1906 (1907)] 69, fig. 8.

*Gerres baconensis* FOWLER, Bull. U. S. Nat. Mus. 100 pt. 12 (1933) 245.

Dorsal IX, 10; anal III, 6; scales in lateral line 40 to 42; transverse series 14 to 15.

Depth 2.5; head 3.1 to 3.3; snout 3.1 to 3.2 in head; eye 3.2 to 3.33, greater than or almost equal to snout, 1.1 to 1.3 in interorbital; maxillary reaches level of front pupil edge. Teeth villiform, in narrow bands in jaws; interorbital 2.5 to 2.8, slightly convex, with a median depression; groove with scales, with only small median circular area, but half of pupil in diameter. Gill rakers 5 + 6, short points about 0.5 of gill filaments. Cheek with four rows of scales to preopercle ridge. Scales with five to eight basal radiating striæ; circuli very fine. Predorsal scales twenty-four to twenty-six, until about nostrils. Second spine of dorsal 1.3 to 1.5 in head; first ray 2.8 to 3. Third spine of anal 2.5 to 3, first ray 2.5 to 2.8 least depth of caudal peduncle 2.6 to 2.8, ventral 1.3 to 1.7; pectoral 3.1 to 3.2.

Back brown, with bright lilac and silvery reflections. Lower sides silvery white. Lips pale or whitish, spinous membranes dusky to even blackish at edge; each membrane pale brown basally, partly concealed by basal scaly sheaths. Anal with brown dots anteriorly.

Known only from the Philippine Islands.

The above description is based on No. 1106, 128 mm, Catbalogan, Samar, September 2, 1907, the only example of *Gerres baconensis* in the collection. The fish tallies with the description given by Fowler, but no scales are found on the premaxillary groove.

**GERRES MACROSOMA Bleeker. Plate 3, fig. 3.**

*Gerres macrosoma* BLEEKER, Nat. Tijdschr. Ned. Ind. **6** (1854) 56; GÜNTHER, Cat. Fish. Brit. Mus. **1** (1859) 353; **4** (1862) 263; DE BEAUFORT, Bijd. Dierk. Amsterdam **19** (1913) 121; FOWLER, Proc. Acad. Nat. Sci. Phila. (1923) 41; FOWLER, Mem. B. P. Bishop Mus. **10** (1928) 224.

*Diapterus macrosoma* BLEEKER, Atlas, Ichth. Ind. Neerland. **8** (1873–1877) 126, pl. (78) 362, fig. 5.

*Xystaema macrosoma* JORDAN and SEALE, Bull. U. S. Bur. Fish. **25** [(1905) 1906] 272.

Dorsal IX, 10; anal III, 7; scales in lateral line 42 to 43; transverse series 16.5 to 17.

Body oblong, with rostrodorsal profile slightly convex with a very small median concavity anterior of eye; the bordering scales reaching nostrils; height 3 to 3.1; head 3 to 3.2 in length. Eye 3 to 3.2 in head, equal to interorbital space and to snout. Maxillary reaching anterior margin of eye; mandibulary profile straight, length 2.5 in head, teeth fine, in moderate bands in jaws; interorbital 3.3. Gill rakers 6 + 7, lanceolate, 0.4 of gill filaments; upper four rudimentary. Distance of dorsal origin to end of snout much greater than height of body but less than entire length of dorsal. Second dorsal spine the longest, 1.5 to 1.6 in head, first ray 3 to 3.5; second and third anal spines subequal, 2 in second dorsal spine and about equal to eye. Pectorals equal head and about equal to depth of body; ventrals 2 in pectorals. Upper lobe of caudal about equal to length of head. Caudal deeply forked, with least height of caudal peduncle less than its length. Pale brownish on back, sides and below silvery whitish; iris grayish; spinous dorsal with a blackish margin.

*Habitat.*—East Indies, Philippines, Melanesia, Micronesia, Polynesia, and Hawaii.

The above description is based on No. 4325, 77 mm, Zamboanga, June 3, 1908.

MINDORO, Mindoro Province, Calapan, No. 11984, 115 mm, January, 1921. BANTAYAN, Cebu Province, Bantayan, Nos. 24104, 24106, 24105, 16323, 24107, 24103, 113 to 145 mm, January 2, 1929. CEBU, Cebu Province, Cebu, No. 1927, 114 mm, September 27, 1907. COMIRAN, Palawan Province, Comiran, No. 15631, 60 mm, November 17, 1927. LUMBUCAN, Palawan Province, Lumbucan, Nos. 15672, 24116, 24118, 24119, 24120, 24121, 24122, 24123, 24124, 24125, 24126, 24127, 24128, 24129, 24130, 24131, 24132, 24134, 24135, 24136, 24137, 29 to 90 mm, November 14, to 29, 1927. PALAWAN, Palawan Province, Puerto Princesa, No. 5384, 77 mm, August 19, 1908. CUYO, Palawan Province, Cuyo Island, No. 2048, 58 to 60 mm, August 1, 1907. SIQUIJOR, Oriental Negros Province, Lazi, No. 1368, 65 mm, September 6, 1907. MINDANAO, Zamboanga Province, Zamboanga, Nos. 2023, 4421, 55 to 70 mm, April 14, 1908: Davao Province, Davao, No. 3508, 64 mm, April 29, 1908. JOLO, Sulu Province, Jolo, No. 24088, 58 to 72 mm, March, 1926. SITANKAI, Sulu Province, Sitankai, No. 4643, 77 mm, July 5, 1908.

# ILLUSTRATIONS

[Drawings by A. Lagman. The scale line beside each fish represents 2 centimeters.]

PLATE 1

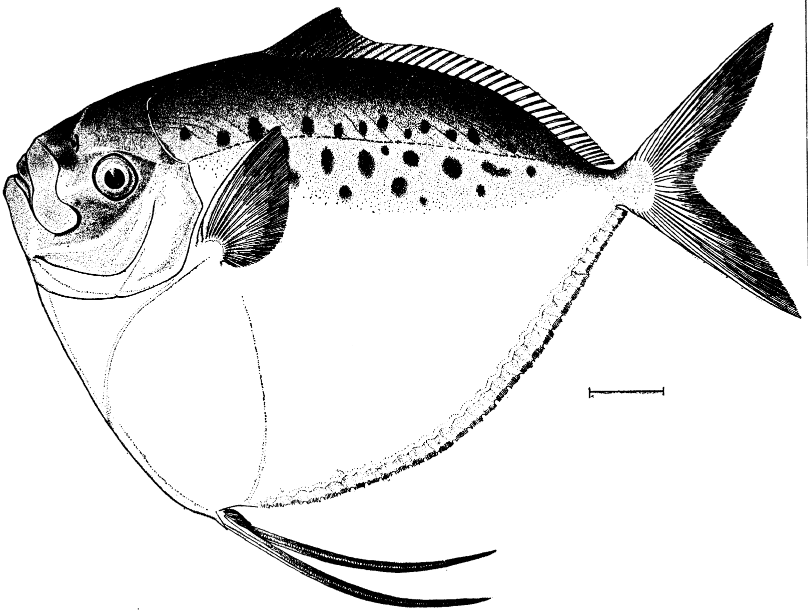
FIG. 1. *Mene maculata* (Bloch and Schneider).
2. *Gerres abbreviatus* Bleeker.

PLATE 2

FIG. 1. *Gerres filamentosus* Cuvier.
2. *Gerres kapas* Bleeker.
3. *Gerres oyena* (Forskål).

PLATE 3

FIG. 1. *Gerres oblongus* Cuvier and Valenciennes.
2. *Gerres baconensis* (Evermann and Seale).
3. *Gerres macrosoma* Bleeker.



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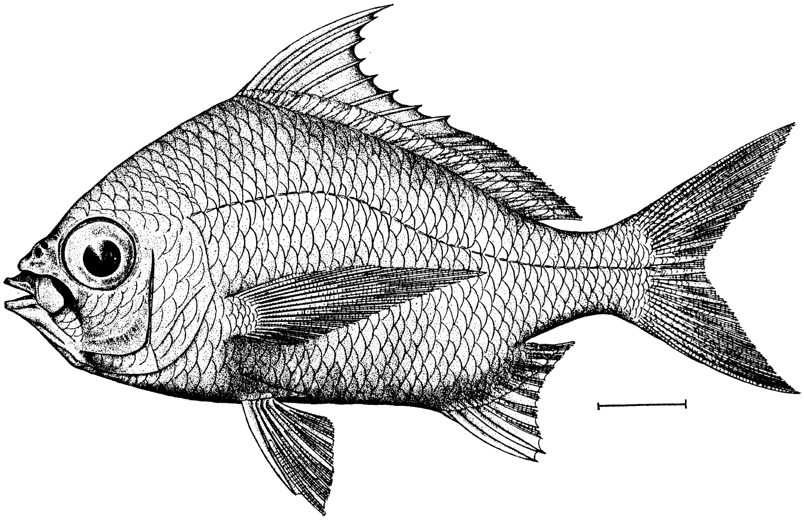

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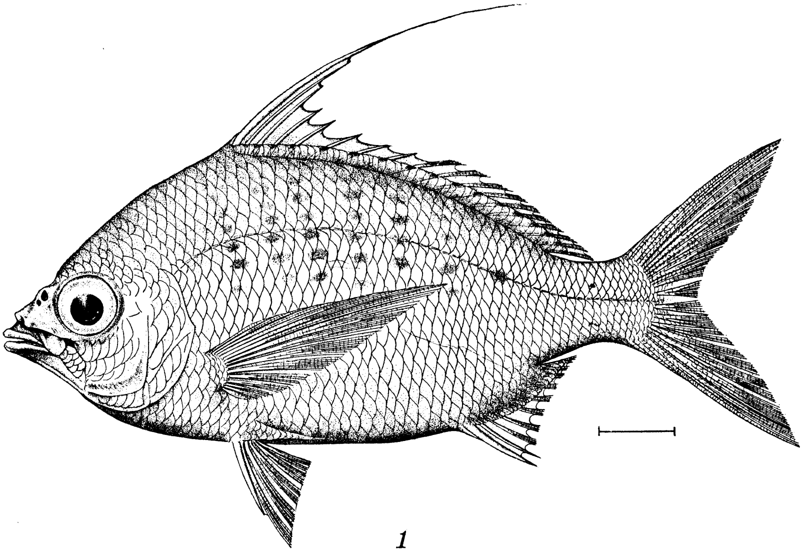

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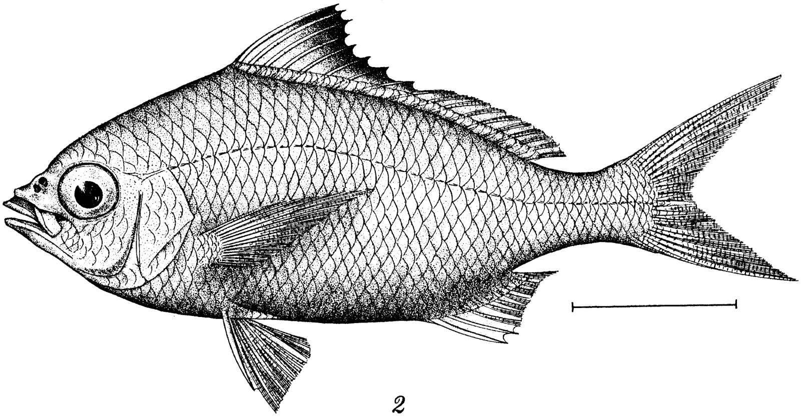

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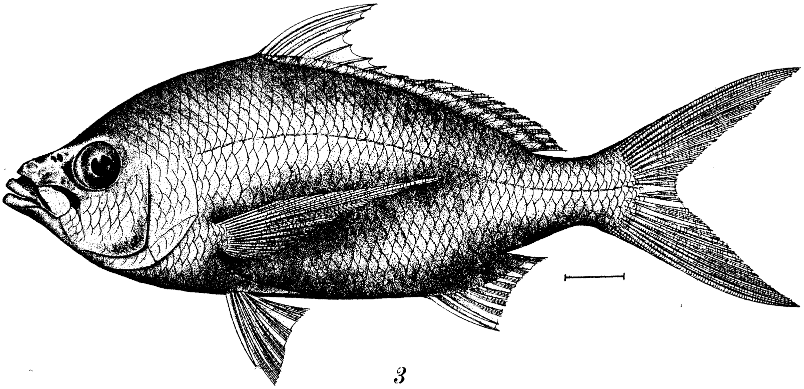

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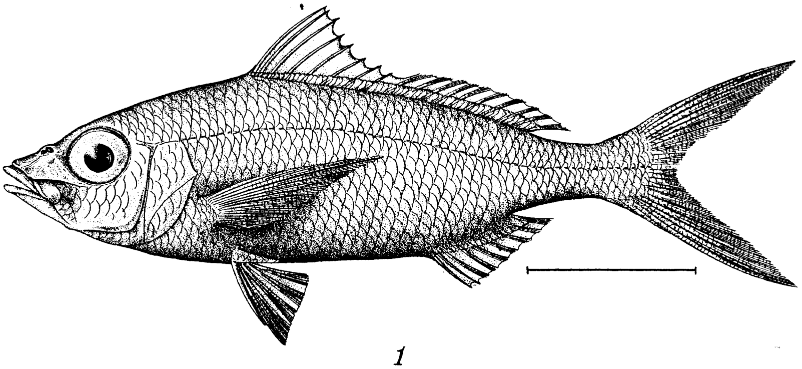

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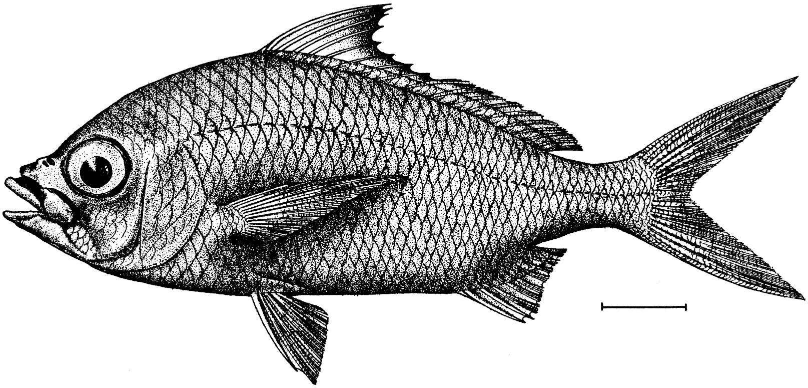

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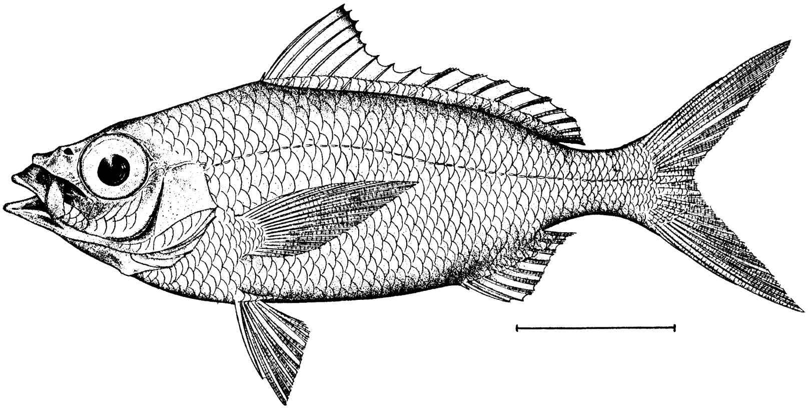

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PLATE 3.

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# LYMNÆA PHILIPPINENSIS, AN INTERMEDIATE HOST OF FASCIOLA HEPATICA IN THE PHILIPPINES, WITH SOME OBSERVATIONS ON THE BIONOMICS OF THE PARASITE.[1]

By ZACARIAS DE JESUS

*Of the Veterinary Research Division, Bureau of Animal Industry, Manila*

ONE PLATE

## INTRODUCTION

The complicated life history of the common liver fluke of ruminants, *Fasciola hepatica* Linnæus, 1758, was thoroughly studied by Thomas (1883) and Leuckart (1879, 1886). Later the various phases of the life history were further elucidated by Ssinitzin (1914), Shirai (1925, 1927), Ross and McKay (1925, 1929), Ross (1930), Shaw and Simms (1930), Shaw (1932), Krull (1933), and Stewart (1934). In all cases only definite species of snails indigenous in certain countries and belonging to the family Lymnæidæ Keferstein were found to be the indispensable intermediate hosts in the complete life cycle of this trematode parasite.

The importance of the determination of the specific intermediate host of this liver fluke lies in the fact that it would greatly help veterinarians to institute definite measures in the control and prevention of fascioliasis in ruminants. In other countries the snail intermediate hosts of *F. hepatica* have been determined. In England and continental Europe, according to Thomas (1883) and Leuckart (1886), the host is *Lymnæa truncatula* (Müll.). In Japan *Lymnæa pervia* Martens was determined as host by Shirai (1925) and in Australia *Lymnæa brazieri* Smith, by McKay (1926). *Galba cubensis* was established as a host in Porto Rico by Van Volkenberg (1929) and Hoffman (1930). Sinitsin (1929) discovered that *Galba bulimoides techella* Halderman from Louisiana is an intermediate host of *F. hepatica. Galba bulimoides* Lea, *Galba ferruginea* Halderman, and *Fossaria modicella* Say were determined as hosts in the western part of the United States by Shaw (1929), Shaw (1931), and Krull (1933), respectively. In Argentina Bacigalupo (1933) considers *Lymnæa viatrix* d'Orb a probable intermediate host of *F. hepatica,* and in India, Bhalerao (1933) definitely determined that *Lymnæa acuminata* is a host of *Fasciola gigantica,* which is a species related to *F. hepatica.*

---

[1] Bureau of Animal Industry Technical Bulletin 8. Read before the Philippine Society of Parasitology, July 17, 1935.

In the Philippines the molluscan intermediate host of *F. hepatica* has not been definitely identified despite the fact that 19 per cent of mature cattle, according to Robles (1932), from different cattle-raising provinces and brought to Manila for slaughter, were found post mortem to be infested with liver flukes. It is highly probable, however, that under field conditions the incidence of infestation is higher, because some infested animals die at an early age. Thus, Tubangui (1935) points out that one of the unsolved problems in veterinary parasitology in the Philippines is the determination of the intermediate host of the common liver fluke of ruminants. While no case of human infestation with *F. hepatica* has been reported in the Philippines, many cases have been recorded in other countries and more recently Bacigalupo (1933) and Chatron (1933) have added to the already long list of recorded cases.

The present study is an attempt definitely to determine the molluscan intermediate host in the Philippines of *Fasciola hepatica* and incidentally to make some observations on the bionomics of this trematode under local climatic conditions.

## COLLECTION OF LYMNÆID SNAILS

In August and September, 1934, the writer collected a great number of species of snails belonging to the family Lymnæidæ from swamps, rice paddies, *barit* grass fields, and irrigation ditches in Laguna, Bulacan, and Pampanga, particularly in certain localities that were known to have had cases of fascioliasis in ruminants. These lymnæid snails were *Amphipeplea* spp., *Planorbis* spp., *Gyraulus prashadi* Faustino, *Physa* spp., and

*Lymnæa philippinensis* Nevill. They were cultured in large trays and pans the bottoms of which were covered with mud and water and various hydrophytes.

### EXAMINATION OF THE SNAILS FOR NATURAL INFECTION WITH LARVAL TREMATODES

Fifty of each species of lymnæid snails in the collection were examined for larval trematodes by gently breaking up their soft shells, then teasing out the livers and examining them under a microscope. About 20 per cent of both *Planorbis* spp. and *G. prashadi* and only about 2 per cent of *L. philippinensis* naturally harbored sporocysts, rediæ, and cercariæ. On the other hand all *Amphipeplea* spp. and *Physa* spp. in the collection were negative.

### ATTEMPTS TO INFECT LABORATORY ANIMALS WITH THE CERCARIÆ NATURALLY FOUND IN THE SNAILS

No attempt was made to determine morphologically the species of these cercariæ, but they were tried for their infectivity.

August 24, 1934, several *G. prashadi, Planorbis* spp., and one *L. philippinensis* were observed shedding cercariæ. The first two were cultured together in one tray and the last one in another tray. Pieces of leaves and tender stems of several species of hydrophytes were immersed in the water in the snail cultures from August 24 to September 17, 1934, inclusive. Then, these leaves and stems were fed to six guinea pigs. When killed and examined four months later all these guinea pigs were found negative for liver flukes.

### DISCOVERY OF THE MOLLUSCAN INTERMEDIATE HOST

In September, 1934, many *Lymnæa philippinensis, Amphipeplea* spp., and *Physa* spp. were collected every week from a barit grass field just outside the town of Biñan, Laguna. Examinations of fifty individuals of each species in this collection revealed that they were all negative for larval trematodes.

September 8, 1934, both species were cultured in one large tray and were subjected to artificial infection with miracidia of *Fasciola hepatica* hatched from ova collected from the gall bladders of infested cattle and carabaos. There were about twenty miracidia to every snail. Three weeks later all of the one hundred twenty *L. philippinensis* and eleven of the fifty *Amphipeplea* spp. had died, but none of the twenty-seven *Physa* spp. died. But in the uninfected culture, or control, of *L. philippinensis,* only a few of the mature individuals died. Examinations of the snails that were found dead in the culture in the morning and in the afternoon during the third week of infection showed that all the *L. philippinensis* were heavily infested with sporocysts and rediæ. The death of all the *Lymnæa* snails in the infected culture must have been due to heavy infection with larval stages of *F. hepatica,* which, as Rees (1931) points out, leads to the disintegration of the host's tissues. Of the *Amphipeplea* snails that died and those that remained alive, as well as all the *Physa* snails, none were found positive.

A great number of miracidia were placed in a watch glass containing a thin layer of water. When observed through a binocular microscope they appeared to be almost uniformly distributed. But as soon as a *L. philippinensis,* whether young or old, was placed in the same watch glass the miracidia seemed to be excited and swarmed toward the snail like an advancing and thickening cloud ring around the mollusk. Some of them darted and pierced the head and foot of the snail, while others were actually seen burying themselves in the foot of the snail. This method of observing the actual penetration of the miracidium into the intermediate host is just a slight modification of that adopted by Barlow (1925) in the case of *F. buski* and by Tubangui and Pasco (1932) in the case of *Euparyphium ilocanum.*

## IDENTITY AND HABITS AND DISTRIBUTION OF LYMNÆA PHILIPPINENSIS NEVILL

The snail was identified as *Lymnæa philippinensis* Nevill by Dr. J. Bequaert, of Harvard University, to whom shells and preserved specimens were submitted through the kindness of Dr. M. A. Tubangui, of the Bureau of Science. This snail (Plate 1, figs. 1 to 6) is described by Nevill (1881) as follows:

> Shell scarcely rimate, small, horn coloured, conically globose, longitudinally striate under the lens; spire short, apex rather pointed; whorls four, the upper ones very small, scarcely convex, the last one very large in proportion, tumidly ventricose; aperture ovate, large, proportionately unusually broad, margins joined by a thin callosity, outer margin boldly, convexly rounded; columella straight, very slightly twisted, broadly reflected, rounded at base.
>
> Long 8½, diam. 5½; apert. alt. 5¾, lat. 4 mil.
>
> Hab.—Lucban, Luzon (Philippines), coll. R. Hungerford Esq.

In describing this snail, Rehn (1893) states that *Lymnæa* (*Fossaria*) *philippinensis* Nevill is very closely related to *L. pervia* Martens, of Japan and China. The latter is the very species of snail that was discovered by Shirai (1925) to be an intermediate host of *F. hepatica* in Japan.

In nature and during life, this small snail possesses a dark color (Plate 1, figs. 1 and 2) varying from dark brown to black, depending upon the color of the mud in the habitat. Whitish spots about 1 millimeter in diameter are sparsely scattered all over the body so that upon closer observation the mollusk assumes a mottled appearance. Its shell is so brittle that it can be easily crushed betwen the thumb and index finger.

This snail is amphibious in habit. It can be seen on stems and leaves of plants and on floating débris a few millimeters above the surface of the water. When on the sides of grass-covered dikes of rice paddies, it may climb as high as 10 centimeters above the water. On drying mud in the laboratory individuals remain viable for seven to twelve days, most of them hiding in the cracks.

The spread of the species in a locality is facilitated by its ability to swim and by its habit of clinging to floating débris. Hence it can be carried by water from place to place. In swimming its position is upside down, its shell being submerged while its foot is spread about the level of the surface of the water. It can submerge or float at will. Many specimens were actually collected from the surface of the water in irrigation ditches. It is found in swamps, ponds, pools, rice paddies, barit grass fields, slow-flowing streams, and irrigation ditches. The writer failed to find it in rice paddies that are dry during the dry season.

The snail is widely distributed in the Philippine Islands. The writer found this mollusk in great numbers in Pampanga, Bulacan, Laguna, and Rizal Provinces, and in swamps in Manila. Literature on this snail and the collection in the Philippine National Museum show that it is also found in Samar, Leyte, Cebu, Tayabas, and Batangas Provinces. Through the courtesy of Drs. Vicente Ferriols and Estefano C. Farinas and the field veterinarians of the disease control division, Bureau of Animal Industry, specimens of this snail are being collected in various parts of the Philippines. It has been found that this snail also occurs in Occidental Negros and Pangasinan Provinces.

## EXPERIMENTS AND RESULTS

### DETERMINATION OF THE INCUBATION PERIOD OF THE OVA OF FASCIOLA HEPATICA DURING THE WET AND DRY SEASONS

*Experiment 1.*—Ova of *Fasciola hepatica* were collected from the gall bladders of infested cattle and carabaos at the Manila Matadero. These were washed many times with plain tap water and were cultured in aquaria the bottoms of which were covered with sand and gravel. The water was from 1 to 5 centimeters deep and was replenished whenever necessary, and plenty of common algæ and other hydrophytes were provided to balance the aquaria. The cultures were kept in the laboratory with glass walls and windows, and were so placed close to the windows that they were exposed to direct sunlight from 6.30 to 9 a. m.

In four trials during August and September, 1934, which fall within the wet season in the Philippines, the eggs began to hatch after an incubation period of from eleven to thirteen days and the hatching continued for ten to fifteen days. In three trials during April, 1935, which falls within the dry season, the eggs began to hatch after an incubation period of from ten to eleven days and the hatching continued for ten to fifteen days.

### DETERMINATION OF THE PROBABLE PERIOD REQUIRED TO COMPLETE THE INTRAMOLLUSCAN DEVELOPMENT

*Experiment 2.*—October 26, 1934, many young *Lymnæa philippinensis* were collected from a rice paddy in Biñan, Laguna. Only one of the fifty snails examined was found to be infested with sporocysts, rediæ, and cercariæ. The remaining one hundred twenty snails were cultured in one large tray containing some water and a layer of mud on which were scattered some common algæ and other hydrophytes to simulate the natural habitat of the snails. Every twenty of these snails were exposed for two hours to from thirty to fifty miracidia in a Petri dish. The culture was placed closed to a window in a corner of the laboratory with glass walls and windows so that the tray was exposed to direct sunlight from 6.30 to 9 a. m. The dead and inactive snails in the culture were examined for the different forms of trematode larvæ, and in the fourth and fifth weeks the snails that survived were placed every morning in beakers with water 1 centimeter deep, and observed every thirty minutes until late in the afternoon.

November 3, 1934, or eight days after infection, all of the five snails examined contained young sporocysts, but no rediæ were found; and November 19, 1934, or twenty-four days after infection, most of the snails examined harbored rediæ, some of which contained undeveloped cercariæ, while the others contained sporocysts.

November 30, 1934, or thirty-five days after infection, two of the remaining twenty-three snails were shedding cercariæ; December 3, 1934, or thirty-eight days after infection, five other snails began to shed cercariæ; and December 7, 1934, or forty-one days after infection, three other snails began to shed cercariæ.

December 14, 1934, or forty-eight days after infection, one of the surviving eleven snails began to shed cercariæ; this snail died the next day. December 17, 1934, or fifty-one days after infection, all the remaining ten snails died. Upon examination they were found to harbor rediæ, most of them with fully developed cercariæ.

### LIBERATION OF THE CERCARIÆ AND THE FORMATION OF CYSTS

*Experiment 3.*—December 4, 1934, four of the five snails that were observed to shed cercariæ on the previous day, as mentioned in experiment 2, were placed in a large beaker containing a little water and some algæ. Examinations for the presence of cercariæ were made every thirty minutes from 7.30 a. m. to 6.30 p. m., inclusive. At 1 p. m. seven cercariæ were found actively swimming in the water. The number of cercariæ increased rapidly at 3 p. m. At 6 p. m. several cysts were seen on the sides of the beaker about the level of the surface of the water. At 6.30 p. m. all four snails were still shedding cercariæ.

December 5, 1934, at 7 a. m. no more free-swimming cercariæ were seen, but many cysts were found attached to the sides and bottom of the beaker and to the shells of two of the snails. The cysts were removed from this culture. At 12 noon one free-swimming cercaria was seen in the culture, and at 1 p. m. every snail was already shedding cercariæ. Pieces of stems and leaves of several species of hydrophytes were immersed in the water in the culture. Cysts were observed to form on the plants even as early as 4 p. m. The next morning cysts were found attached to pieces of leaves and stems of plants as well as to the sides and bottom of the beaker.

December 6, 1934, at 7.45 a. m., two of the four snails in the beaker culture were found dead. At 11.30 a. m. one snail began to shed cercariæ, and at 12 noon both snails were shedding cercariæ and were still shedding cercariæ at 6.45 p. m. The next day the last two snails died in the morning. Each had several rediæ and many fully developed cercariæ.

One snail shedding cercariæ was cultured in a separate beaker and was observed every day from December 3, 1934, until it died. It shed 32 cercariæ the first day, 78 the second day, 149 the third day, and 110 the fourth day, or a total of 369 cercariæ. When it died it was found to contain three young rediæ and two old ones containing about one hundred fully developed cercariæ and many more undeveloped ones.

The formation of cysts was observed to be accomplished in fifteen to forty-five minutes from the time a free-swimming, actively motile cercaria settles on a solid object. At first it sticks to a point by its suckers; its body contracts and becomes circular in outline. In the meantime the tail keeps on lashing and wiggling and later snaps off at the base. As shown in Plate 1, figs. 7 and 8, the cysts appeared like tiny moles measuring about 0.2 millimeter in diameter and about 0.1 millimeter in thickness. They are yellowish white in color. Mere washing of the leaves and stems of plants to which they were attached did not dislodge them.

## INFECTION EXPERIMENTS

Besides rabbits and guinea pigs, goats were also used in the infection experiments. The young goats were born and raised in a pen with a cement floor and were fed only with guinea and napier grasses from a well-drained field. These young goats or kids as well as their mothers were found negative for ova of *Fasciola hepatica* on repeated fæcal examinations.

### INFECTION WITH FREE-SWIMMING CERCARIÆ

*Experiment 4.*—December 3, 1934, each of four guinea pigs and one rabbit was drenched with water containing twenty-five free-swimming cercariæ coming from five snails. When killed and examined April 2, 1935, these guinea pigs and the rabbit were negative for liver flukes.

December 5, 1934, goat 79 was drenched with water containing one hundred free-swimming cercariæ coming from five snails. When killed and examined March 23, 1935, it was found negative for liver flukes.

December 6, 1934, rabbit 1 was fed with fifty free-swimming cercariæ coming from two snails. This rabbit was later found negative for liver flukes when killed and examined April 2, 1935.

### INFECTION WITH ENCYSTED CERCARIÆ

*Experiment 5.*—December 3, 1934, goat 47 was fed with seventeen cysts from two snails, mixed with pieces of stems of guinea grass. When the goat was killed and examined March 23, 1935, or one hundred ten days after infection, two mature *Fasciola hepatica* were found in the liver.

December 14, 1934, rabbit 2 was fed with many pieces of stems and leaves of guinea grass and kangkong [*Ipomœa reptans* (Linn.) Poir.], which had been immersed for seven days in the water in the culture described in experiment 2. When the rabbit was killed and examined February 5, 1935, or fifty-three days after feeding, several immature *F. hepatica,* measuring from 8 to 18 millimeters long, were found in the liver.

## FIELD EXPERIMENT

*Experiment 6.*—A small area, measuring 6 by 10 meters, in a barit grass field in Pandacan, Manila, was fenced. The snails found in this fenced area were *Pila luzonica* (Reeve), *Vivipara angularis* Müller, *Melania* spp., *Amphipeplea* spp., *Planorbis* spp., *Gyraulus prashadi* Faustino, *Physa* spp., *Assiminea* sp., *Stenogyra* sp., and a few *Lymnæa philippinensis* Nevill. Over five hundred more *L. philippinensis,* from Biñan, were scattered in this area. The water was from 1 to 15 centimeters deep and the barit grass that was grown here was from 30 to 40 centimeters high.

October 21, 1934, a great number of miracidia and embryonated eggs of *Fasciola hepatica* were scattered in the field. November 20, 1934, or thirty days later, twenty-one of the twenty-five *L. philippinensis* examined were found positive for rediæ, some of which contained cercariæ; and December 2, 1934, or forty-two days later, none of the seventy-seven *L. philippinensis* collected from the infected field shed cercariæ. December 4, 1934, or forty-four days after the miracidia were scattered in the field, three of the fifty *Lymnæa* snails were shedding cercariæ. All of these snails were returned to the field.

December 14, 1934, or fifty-four days after the field was infected, two of the eleven *Lymnæa* snails collected were shedding cercariæ, while seven of the remaining nine were positive for sporocysts, rediæ, and cercariæ, and two were negative.

## FEEDING THE GRASS FROM AN INFECTED FIELD

December 2, 1934, or forty-two days after the field was infected, some of the barit grass was cut and fed to goat 78. Some of the stems of the grass were cut a little below the surface of the water. When this young goat died of pneumonia January 10, 1935, or thirty-nine days later, it was negative for liver flukes.

December 7 and 8, 1934, or forty-seven to forty-eight days after the field was infected, two wheelbarrows of barit grass, which had been cut and immersed in water in the infected area for twenty-four to forty-eight hours, was fed to an old bull, B. A. I. 3338. This bull was brought from Tanauan, Batangas, where it was raised and always tied, being a work animal, on a farm in Barrio Kale, situated on a well-drained plateau, with neither brook nor spring in the vicinity. In the Bureau of Animal Industry in Pandacan, Manila, it was fed with dry, old rice straw and some napier grass from a well-drained field and had been always tied in a shed with cement floor since May 31, 1934. Repeated fæcal examinations showed that the animal was negative for ova of both trematodes and nematodes. When this bull died of babesiosis February 2, 1935, or fifty-six days after the last feeding, it was found post mortem to be heavily infested with immature *Fasciola hepatica* from 8 to 17 millimeters long.

## DISCUSSION

In this investigation *Lymnæa philippinensis,* a snail indigenous and widely distributed in the Philippine Islands, is definitely determined for the first time as the intermediate host of *Fasciola hepatica.* This finding will certainly give a more definite working basis for the control and prevention of fascioliasis in ruminants in the Philippines.

The incubation period of the eggs of *Fasciola hepatica* is from eleven to thirteen days during the wet season and from ten to eleven days during the dry season. According to the Philippine Weather Bureau, the average temperature in Manila from 1885 to 1933 is from 24.7° to 28.4° C. These results are in agreement with those of Ross and McKay (1929) when they incubated the eggs at a temperature of 26° to 27.5° C. and when they hatched the eggs at room temperature during midsummer in New South Wales when the temperature ranged from 18° to 30° C., which is almost the same range as the prevailing temperature in Manila throughout the year. On the other hand, in Oregon Shaw (1931) reports that the eggs of *Fasciola hepatica* have been known to hatch over a period of thirteen months. Thomas (1883) points out that a temperature of about 23° to 26° C. is most favorable. Hence, the prevailing temperature in the Philippines throughout the year is very favorable for the incubation of the ova of *F. hepatica.*

In this investigation, the intramolluscan development was completed in from thirty-five to forty-eight days after infection under laboratory conditions, but in the field, it was from forty-four to forty-eight days. This is quite in agreement with the result obtained by Krull (1933), who reports that snails (*Galba modicella*) began to shed cercariæ thirty-two to forty-two days after they had been subjected to the miracidia in summer; and also with that obtained by Ross and McKay (1929), who found cercariæ escaping in summer in a minimum period of forty-nine days after infection of the host (*Lymnæa brazieri*). In Japan Shirai (1925) observed the mature cercariæ coming out of *Lymnæa pervia* in from forty-five to seventy days after infection. On the other hand, in Oregon Shaw (1932) found that cercariæ from artificially infected snails (*Galba bulimoides*) were discharged four months twenty-seven days after infection. The duration of the shedding of cercariæ could not be ascertained, because the snails died after shedding every day for two to four days. The high prevailing temperature in the Philippines may account for the relatively short period of the intramolluscan development herein reported.

In no case was an infected *Lymnæa philippinensis* observed to shed cercariæ in the morning. Most infected snails began to shed cercariæ between 12 noon and 1 p. m. The earliest time observed was 11.30 a. m., and this was observed but once. Rees (1931) observes that under normal conditions certain species of cercariæ, like *C. limbifera* (Seifert) and *Cercaria "Z"* (Rees), emerged during the daytime only. This author also observes that continual darkness causes a decrease in the numbers emerging, a lowering of the temperature partially or completely checks the escape of the larvæ. Cort (1922) asserts that the emergence of echinostome larvæ during the daytime only is due to the positive reaction of these larvæ to light, but Rees (1931) states that in all cases this phenomenon cannot be attributed to positive phototropism, because she found *Cercaria "Z"* to be negatively phototropic and *C. limbifera* positively phototropic, yet both these larvæ emerge during the daytime and not during the night under normal conditions. Thus, this investigator asserts that a possible explanation seems to be temperature in that the gradual rise of temperature during the day may accelerate the rate of development of the cercariæ and so bring about their emergence. Since no free-swimming cercariæ could be seen at 6 a. m. the next day, the shedding of cercariæ must have stopped sometime late in the evening of the previous day.

In the laboratory, in the presence of pieces of stems and leaves of grass, encystment was observed to begin between 5 and 6

p. m., and only in one instance at 4 p. m. Then, at 6 a. m. the next day, no more free-swimming cercariæ could be found, as all had already encysted so that all the cercariæ must have encysted late in the evening.

The highest point on the sides of the beaker where the cysts were found attached was about 5 millimeters above the water level. Ssinitzin (1914) observes that cercariæ may encyst on plants to a depth of 2 centimeters below the water level and even up to 2 centimeters above the water level. In the present study the water in the beaker was only 1 centimeter deep, and most of the cysts were found on the bottom of the beaker or on the pieces of stems of plants placed thereon. Ross and McKay (1929) report that where snails excreted cercariæ in water not more than 2 centimeters deep 6 per cent of the cercariæ would encyst on the dish rather than on water weeds or sides of the dish and that where the water was less than 2 centimeters deep up to 10 per cent of the cercariæ would encyst on the bottom. Later, Ross (1930) observes that the cercariæ would encyst at very much greater depths, from 4.5 to 10.5 centimeters.

In the present study no experiments were performed on the resistance of the cysts. However, Shirai (1927) found that the cysts could remain alive for eighty days in fresh water at a temperature of about 22° to 31° C., which is almost the same as the prevailing temperature in the Philippines. According to this author the cysts adhering to the leaves remained infective after having been exposed and dried under direct sunlight at 35° C. for three hours or dried in the shade at 26° C. for twenty-four hours. The same investigator found that if the cysts were dried in the shade at 25° to 32° C. for seventy-two hours they lost their infective power.

All attempts to infect susceptible animals with free-swimming cercariæ failed. This finding confirms the observation of Shirai (1927) and finds support in the work of the same investigator, who reports that the cysts are entirely noninfective within a few hours after encysting, but a certain number of the cysts reach an infective stage after the lapse of twelve hours.

Feeding cysts of cercariæ, which were liberated the preceding day, to a goat and a rabbit, resulted in the infection of these animals. In the case of the rabbit, which was killed fifty-three days after infection, the liver flukes recovered from the sinuses of the liver were immature and only from 8 to 18 millimeters long; in the case of the goat, which was killed one hundred ten days after infection, the two flukes found in the liver were already mature but not yet laying eggs. Krull (1933) found the fæces of rabbit positive for eggs of *F. hepatica* one hundred two days after feeding the encysted cercariæ. In three experimentally infested rabbits, which were guarded against any apparent possibility of further infestation, Montgomerie (1931) recovered the flukes from the first rabbit, which died thirteen months later; from the second rabbit, which was killed two years seven months later; and from the third rabbit, which died three years one month later. The same writer observes that periodic counts of the eggs passed in the fæces did not suggest any gradual diminution of infestation, but after a preliminary rise it fell to a constant level, from which it was calculated that each fluke produced 1,181,000 eggs. In natural infestation Dizier (1933) reports a case of fascioliasis in a calf, five weeks old, wherein four adult liver flukes were found, so that this observer believes that intrauterine infection must have taken place.

Fascioliasis was produced in a bull by feeding it with grass from a field in which *Lymnæa philippinensis* abounds and where miracidia and embryonated eggs of *F. hepatica* were scattered forty-seven to forty-eight days before, but fascioliasis could not be produced in a goat, which was fed with grass from the same place forty-two days after infecting the field. However, after forty-four days, some individuals of *L. philippinensis* were already shedding cercariæ. These results prove that the intramolluscan development of *F. hepatica* under field conditions is completed in from forty-four to forty-eight days.

## SUMMARY

*Lymnæa philippinensis* Nevill, a snail indigenous and widely distributed in the Philippine Islands, is definitely determined as an intermediate host of *Fasciola hepatica.*

This mollusk was observed to be positively chemotactic to the miracidia of *Fasciola hepatica,* and the miracidia developed into other larval stages in this host giving rise to cercariæ.

These cercariæ were definitely identified by successfully infecting a rabbit and a goat from which several specimens of *Fasciola hepatica* were recovered.

The incubation period of the eggs of *Fasciola hepatica* under local climatic conditions is from eleven to thirteen days during the wet season and from ten to eleven days during the dry season, showing that the prevailing temperature throughout the year in the Philippines is favorable for the hatching of the eggs of this liver fluke.

In the laboratory the intramolluscan development of *Fasciola hepatica* was completed in from thirty-five to forty-eight days, but in the field, in from forty-four to forty-eight days.

The emergence of the cercariæ started, in most cases, between 12 noon and 1 p. m. and very rarely before noon, while the encystment of the cercariæ took place apparently late in the evening.

All attempts to infect laboratory animals with free-swimming cercariæ of *Fasciola hepatica* have failed, showing that the free-swimming cercariæ are not infective.

Fascioliasis was successfully produced in a bull by feeding it with grass from a swampy field in which *Lymnæa philippinensis* abounds with other snails, which are known not to act as hosts, and where miracidia and embryonated eggs of *Fasciola hepatica* were scattered forty-seven to forty-eight days before.

The specimens of *Fasciola hepatica* recovered from the liver of a goat, which was killed one hundred ten days after infection, were already sexually mature with gravid uterus but not yet laying eggs.

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# ILLUSTRATION

## PLATE 1

FIGS. 1 to 3. The intermediate host of ***Fasciola hepatica*** Linnæus in the Philippines, *Lymnæa philippinensis* Nevill; *1*, dorsal view; *2*, ventral view; *3*, lateral view. (Photographed by the Publications Division, Department of Agriculture and Commerce.)

4 to 6. Shells of ***Lymnæa philippinensis*** Nevill; *4*, dorsal view; *5*, ventral view; *6*, lateral view.

FIG. 7. A leaf of a hydrophyte showing the cysts of the cercariæ of *Fasciola hepatica* Linnæus. The cysts appear like tiny moles on the leaf and are of lighter color.

8. A piece of stem of a hydrophyte showing the cysts of the cercariæ of *Fasciola hepatica* Linnæus attached to it. (Photographed by the Publications Division, Department of Agriculture and Commerce.)

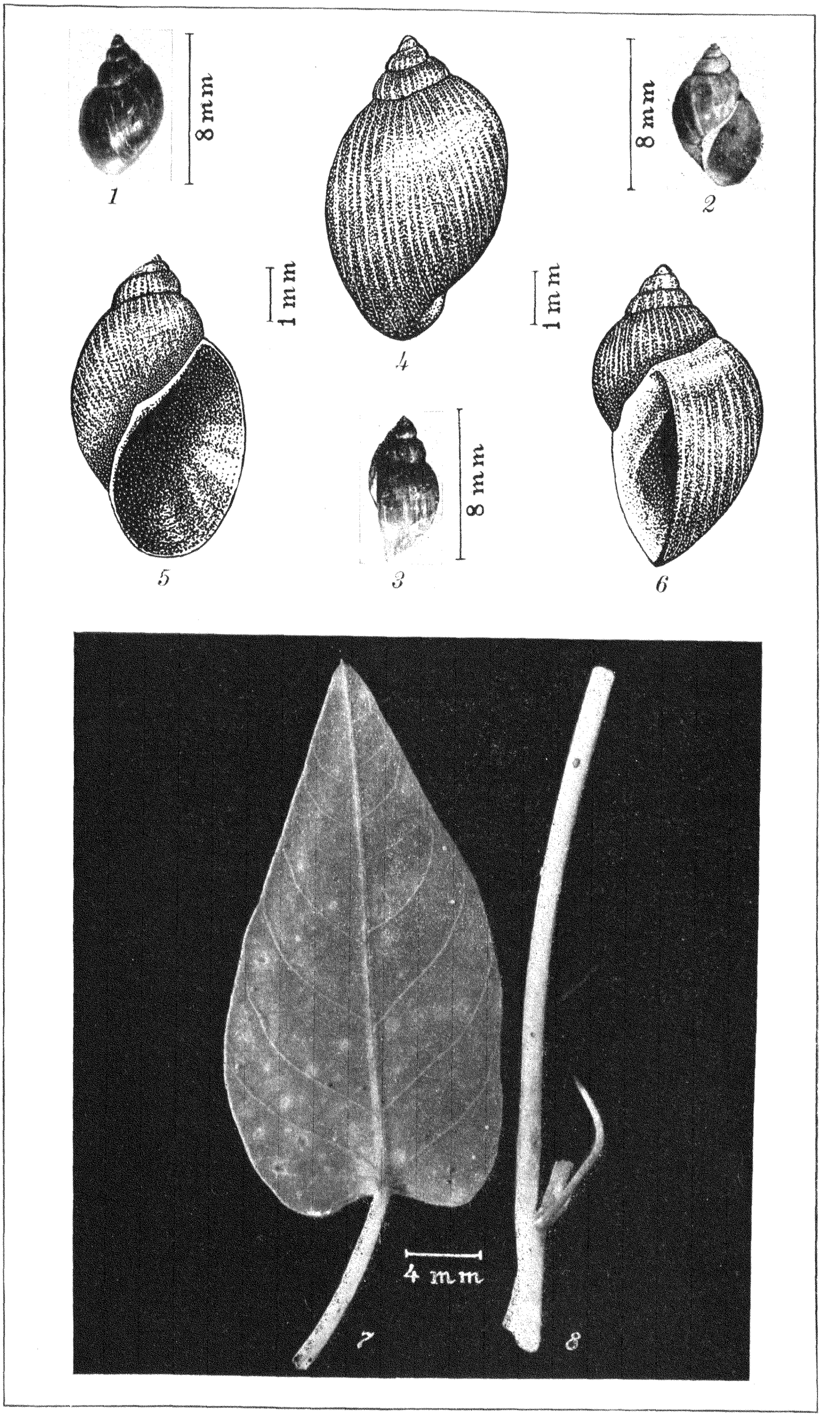

PLATE 1.

UNIV. OF MICH.

# NUTRITIVE MINERAL VALUE OF PHILIPPINE FOOD PLANTS (CALCIUM, PHOSPHORUS, AND IRON CONTENTS)

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Mineral constituents are a very important part of a normal diet in addition to the other necessary food requirements of the body, such as fats, proteins, carbohydrates, and vitamins.

Concerning the general functions of mineral elements in the body Sherman[1] states:

> The elements concerned in the mineral metabolism exist in the body and take part in its functions in at least three kinds of ways:
>
> (1) As constituents of the bones and teeth, giving rigidity and relative permanence to the skeletal tissues;
>
> (2) As essential elements of the organic compounds which are the chief solid constituents of the soft tissues (muscles, blood cells, etc.);
>
> (3) As soluble salts (electrolytes) held in solution in the fluids of the body, giving these fluids their characteristic influence upon the elasticity and irritability of muscle and nerve, supplying the material for the acidity or alkalinity of the digestive juices and other secretions, and yet maintaining the approximate neutrality of the body's fluids as well as their osmotic pressure and solvent power.

Three of the most important mineral elements that the body requires are calcium, phosphorus, and iron. Calcium and phosphorus are always needed in relatively liberal amounts. In addition to their various activities they constitute, as calcium phosphate, about 85 per cent of the mineral matter of bones, or at least three-fourths of the entire ash of the body.

Most of the iron in the body is contained in the blood in the form of hæmoglobins which are proteins containing iron. A considerable portion of the red blood corpuscles is composed of hæmoglobins which function as oxygen carriers in respiration.

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[1] Chemistry of Food and Nutrition (1932) 237.

A few researches[2] have been carried out to determine certain mineral elements in some Philippine food plants, but as yet no extensive survey has been reported.

The object of this investigation was to determine the calcium, phosphorus, and iron contents of a large number of Philippine vegetables and fruits in order to ascertain their relative nutritive value in these important mineral constituents.

## EXPERIMENTAL PROCEDURE

Both the scientific and local names of the plant materials used are given in Table 1, in which the particular parts of the plants employed for analysis are also included.

Most of the specimens were obtained from plants grown in the Philippines and purchased in the city markets of Manila during the dry (spring) season. Some were secured from other districts such as the Mountain and Laguna Provinces while a few were imported. Care was taken to select only fresh and representative specimens.

Immediately upon reaching the laboratory the plant materials were prepared for analysis. All foreign matter, such as adhering soil, was removed. Samples that had been recently watered were allowed to drain and dry in the air until the surface contained no excess water. The edible portion of the plants was separated from the nonedible, which was discarded. A small part of the fresh, edible portion of each specimen was taken for the moisture determination and the remainder was air dried in a greenhouse. The materials that tended to become moldy, when dried in the sun, were heated in an electric oven at a temperature of about 80° C., until sufficiently dry. All of the samples, when dried, were ground to a coarse powder and kept in well-stoppered bottles.

*Analysis.*—The plant materials were analyzed for moisture, ash, phosphorus, calcium, and iron.

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[2] Adriano, F. T., and M. S. de Guzman, Philip. Agr. 20 (1931) 43.—Adriano, F. T., and E. T. Tavanlar, Philip. Agr. 14 (1925) 437.—Aron, H., Philip. Journ. Sci. § B 5 (1910) 81.—Aron, H., and F. Hocson, Philip. Journ. Sci. § B 6 (1911) 361.—Martinez, T. R., Philip. Agr. 21 (1933) 551.—Wells, A. H., F. Agcaoili, and R. T. Feliciano, Philip. Journ. Sci. 20 (1932) 353.—Vedder, E. B., and R. T. Feliciano, Philip. Journ. Sci. 35 (1928) 351.

*Moisture.*—The moisture content was determined by heating a portion of the sample to constant weight in a drying oven at a temperature of 100° to 105° C.

*Ash.*—About 20 to 25 grams of the plant material was charred at moderate heat and the charred mass was then ignited in an electric muffle furnace at a temperature of approximately 450° C. The ash was cooled in a desiccator and weighed.

The major portion of the ash, accurately weighed, was fused with sodium carbonate. The melt was boiled with dilute hydrochloric acid, the solution filtered, and the filtrate made up to a definite volume. Aliquot portions of the measured solution were used for the determination of phosphorus, calcium, and iron.

The results given in Table 2 show that the quantities of phosphorus, calcium, and iron obtained by fusing the ash with sodium carbonate are slightly higher than those obtained by directly dissolving the ash in warm, dilute hydrochloric acid.

In the case of seeds the ashing of the sample for elementary analysis was carried out in accordance with the magnesium nitrate method.[3]

*Phosphorus.*—This was determined in an aliquot portion of the measured acid solution (filtrate) from the ash. The official volumetric method[4] was employed except in the precipitation of ammonium phosphomolybdate where Hibbard's directions[5] were followed.

The official agricultural method for phosphorus determination in plants requires that the sample should be treated with magnesium nitrate solution before ashing. In view of the many samples to be analyzed this method of ashing was not employed except for samples of seeds. Preliminary experiments, recorded in Table 3, showed that there was only a very slight difference in the amount of phosphorus pentoxide obtained by the official agricultural method and the procedure adopted for this investigation.

*Calcium.*—Another aliquot part of the acid solution of the ash was used for this determination. The calcium was precipitated as oxalate and the precipitate after thorough washing was dissolved in hot sulphuric acid and titrated with potassium permanganate (0.1 *N*).[6]

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[3] Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists (1930) 110.

[4] Op. cit. 16.

[5] Journ. Indus. Eng. Chem. 5 (1913) 1000.

*Iron.*—Walker's method[7] for the determination of iron in foods was adopted, using an aliquot portion of the acid solution of the ash.

## RESULTS

In tabulating the results of analysis the samples were arranged according to the following groups: Leafy vegetables; nonleafy vegetables; fruits; seeds; roots, rhizomes, and tubers.

In the tables the percentages of phosphorus, calcium, and iron are expressed in terms of phosphorus pentoxide, calcium oxide, and ferric oxide, respectively, for both the fresh and moisture-free samples and also for the ash.

*Leafy vegetables.*—In Table 4 are given the results of analyzing leafy vegetables. As shown by the data the leafy vegetables are characterized by having a relatively high ash content. They can also be considered as excellent sources of phosphorus, calcium, and iron. Some samples, such as the different kinds of spinach obtained from the Mountain Province (samples 59, 93, 56, and 46), contained more than 20 per cent ash. The phosphorus, calcium, and iron contents of the ash were correspondingly high. These facts are more noticeable in Table 5, in which it is shown that the major portion of the leafy vegetables gave the following average results:

| Constituent. | Per cent. |
|---|---|
| Ash | 10.01 to 20 |
| Phosphorus pentoxide ($P_2O_5$) | 1.01 to 2 |
| Calcium oxide (CaO) | 1.01 to 3 |
| Ferric oxide ($Fe_2O_3$) | 0.01 to 0.19 |

While the leafy vegetables were, in general, rich in mineral constituents the young leaves of these plants gave only a comparatively small amount of ash. For example (Table 4), the young leaves of ciruelas contained only 7.20 per cent ash and those of tamarind had even less (4.50 per cent).

The data given in Table 4 show that there was a notable variation in the amount of ash obtained from different kinds of vegetables. Again, there was quite a difference in the percentages of phosphorus, calcium, and iron in the ash of individual vegetables. For instance, in the leaves of the cashew plant (sample 158) the amount of ash was very small (4.28 per cent) while the percentage of phosphorus in the ash was very high (24.11 per cent). The leaves of Swiss chard (sample 314) contained 20.27 per cent ash, but the amount of phosphorus in the ash was only 3.58 per cent.

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[6] Op. cit. 104.

[7] Hawk, P. B., and O. Bergheim, Practical Physiological Chemistry (1927) 413.

Many of the samples that had a low ash content contained more phosphorus than calcium. The ratio of calcium oxide to phosphorus pentoxide was worked out not only for the leafy vegetables but also for the other plant products analyzed, and the results are recorded in the various tables.

*Nonleafy vegetables.*—This group was an odd assortment of stems, pods, flowers, shoots, and a few fruits. In classifying the fruits, vegetables, and other products analyzed most of the fruits were included in a special group. However, some fruits, such as squash, tomato, and egg plant, which are eaten without leaves and are ordinarily regarded as vegetables, were considered to be nonleafy vegetables. The variation in the mineral constituents of the nonleafy vegetables (Table 6) was even greater than in the leafy vegetables. Green fruits and pods gave an ash content much lower than that of the other kinds of nonleafy vegetables but the amount of phosphorus pentoxide in the ash was very high.

The phosphorus content of the nonleafy vegetables was about the same as that of the leafy ones, but the amount of ash, calcium, and iron was much less.

A majority of the nonleafy vegetables (Table 7) gave the following range of mineral constituents:

| Constituent. | Per cent. |
|---|---|
| Ash | 5.01 to 15.00 |
| Phosphorus pentoxide ($P_2O_5$) | 0.51 to 2.50 |
| Calcium ($CaO$) | 0.26 to 1.25 |
| Ferric oxide ($Fe_2O_3$) | 0.03 to 0.05 |

*Fruits.*—Analyses of a number of different kinds of fruits are given in Table 8. In general, the mineral contituents (ash) of fruits were much lower than those of vegetables. Fruits usually contained somewhat more phosphorus than calcium, but the iron content was particularly low. Sour fruits, such as kalamansi, bignai, blueberry, and tibig, were rather high in calcium as compared to other fruits.

Most of the fruits gave average results (Table 9) as follows:

| Constituent. | Per cent. |
|---|---|
| Ash | 1.50 to 5.00 |
| Phosphorus pentoxide ($P_2O_5$) | 0.10 to 0.60 |
| Calcium oxide (CaO) | 0.02 to 0.50 |
| Ferric oxide ($Fe_2O_3$) | 0.01 to 0.03 |

*Seeds.*—Analyses of seeds (Table 10) gave a relatively lower ash content than those of other plant products. Seeds of *Sesamum orientale* gave the highest ash content, which was only 6.63 per cent. Rice had an exceedingly low amount of ash (0.96 per cent).

The seeds were very low in calcium and iron though the phosphorus was quite high. This abnormal, or unbalanced, proportion of phosphorus and calcium is a characteristic property of these plant products. In the case of rice, for instance, the phosphorus was exceedingly high, for the ash contained 69.38 per cent phosphorus pentoxide. However, the lime content of the ash was only 2.04 per cent.

The following data give the general trend of the seed analyses (Table 11):

| Constituent. | Per cent. |
|---|---|
| Ash | 2.51 to 4.50 |
| Phosphorus pentoxide ($P_2O_5$) | 0.35 to 1.25 |
| Calcium oxide (CaO) | 0.01 to 0.39 |
| Ferric oxide ($Fe_2O_3$) | 0.006 to 0.03 |

*Roots, rhizomes, and tubers.*—As far as mineral constituents are concerned, this group (Table 12) appears to occupy an intermediate position between the nonleafy vegetables (Table 6) and the fruits (Table 8).

Average analyses of most of the samples in this group (Table 13) are given below:

| Constituent. | Per cent. |
|---|---|
| Ash | 3.00 to 12.00 |
| Phosphorus pentoxide ($P_2O_5$) | 0.35 to 1.25 |
| Calcium oxide (CaO) | 0.01 to 0.50 |
| Ferric oxide ($Fe_2O_3$) | 0.003 to 0.04 |

These products had a rather low ash content. The average amount of phosphorus, though low, was considerably greater than the calcium. Most of the materials were very low in iron.

## REVIEW OF DATA

*Plants rich in mineral elements.*—In reviewing the basic analytical results obtained in this investigation we find that some plants, or plant products, serve as excellent sources for particular mineral elements. Data of this nature are given in Table 14 in which the names of plant materials that are very rich in phosphorus, calcium, or iron are recorded. As shown by the table the major portion of these plant materials, rich in mineral constituents, consists of leaves.

*Distribution of mineral elements in different types of Philippine food plants.*—Some idea of the general distribution of ash, phosphorus, calcium, and iron in a few very common (typical) types of Philippine food plants is given in Table 15. A comparison of the data pertaining to the different kinds of plant products analyzed shows again that both the leafy and nonleafy vegetables have a high ash content and are rich in mineral constituents. The leafy vegetables are, however, much higher in calcium and iron than the nonleafy. The fruits, seeds, and underground structures (roots and tubers) are, in general, poor in mineral matter (ash).

*Mineral matter in different parts of plants.*—Table 16 contains some interesting data in that it shows the mineral content in different parts of the same plant. In the case of ampalaya, for instance, the leaves and green fruit were found to contain about the same amount of phosphorus but the percentage of ash, calcium, and iron in the leaves was much greater than in the green fruit (samples 28 and 12). The leaves and flowers of the squash also contained much more mineral matter than the fruit (samples 35, 301, and 141).

*Location and climate in relation to the mineral constituents in leafy vegetables.*—The environmental conditions under which a plant is grown naturally affect the composition of the mineral matter contained in the plant.

If a plant of definite species is grown in different localities the amount of individual mineral elements in the plant may vary a good deal. As a rule, however, the general trend of the analyses is about the same. This is shown by the data in Table 17, from which a few examples are given below:

| Sample No. | Local name of plant. | Place grown. | $P_2O_5$ in ash. | CaO in ash. | Ratio ($CaO:P_2O_5$). |
|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | |
| 20 | Paco | Manila | 19.46 | 1.89 | 1 : 10.30 |
| 20-A | do | Baguio | 15.65 | 2.38 | 1 : 6.58 |
| 23 | Perejil | Manila | 8.12 | 17.55 | 1 : 0.46 |
| 23-A | do | Baguio | 8.55 | 13.96 | 1 : 0.61 |

These two plants, pakó and perejil, were grown near Manila, where the climate is tropical, and also near Baguio, a summer resort situated at an elevation of about 1,500 meters in the Mountain Province of the Philippines. In this mountainous location the climate is about temperate. Specimens of these two plants were, therefore, grown under both tropical and temperate climate conditions.

The plant pakó, when grown near Manila, had a relatively large amount of phosphorus and a small amount of calcium. This is a particular characteristic of the plant, for when grown near Baguio it also had a relatively large amount of phosphorus and a small amount of calcium. The ratios of calcium oxide to phosphorus pentoxide were rather high in both cases, varying from about 1: 6 to 1: 10.

Perejil, when grown either near Manila or Baguio, had a relatively low amount of phosphorus and a high amount of calcium. The ratios of calcium oxide to phosphorus pentoxide were somewhat the same for the two samples and rather low, 1: 0.46 and 1: 0.61.

From this it appears that if a mature plant is high in some particular mineral element and low in another, when grown in a certain locality, it will have the same characteristic when grown properly in other places. There may be variation in the composition of the mineral matter contained in the plant. However, the general trend of the plant-ash analyses is about the same even though the plant is grown under both tropical and temperate climate conditions. This general relation obtains for all the other results recorded in Table 17.

*Calcium-phosphorus ratio.*—In normal nutrition it is not only necessary that the body should have a sufficient amount of mineral elements, such as calcium and phosphorus, but these elements should be acquired in appropriate quantities to be most effective.

According to Sherman,[8] 0.45 gram of calcium and 0.88 gram of phosphorus may be considered the minimum of actual daily need for adult humans. However, the normal allowance should be much more than this. He estimates the optimum daily allowance to be about 1 gram of calcium oxide and 3 grams of phosphorus pentoxide. According to this estimate the optimum calcium oxide-phosphorus pentoxide ratio is 1: 3.

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[8] Chemistry of Food and Nutrition (1932) 512.

In the various tables of analyses the calcium oxide-phosphorus pentoxide ratio has also been included. A review of the tables shows a wide variation in the ratios for individual plants. In Table 18 are given the names of the plants that had mineral matter in which the ratio ($CaO: P_2O_5$) was approximately **1: 3.**

*Selecting plants for proper calcium-phosphorus ratio.*—Out of the large number of samples analyzed only a very few contained mineral matter having approximately the proper ratio ($CaO: P_2O_5$).

The analytical results given in the tables are of practical value. For by selecting plant materials that have appropriate ratios ($CaO: P_2O_5$) and combining them in the right proportions the resulting product will have the proper calcium oxide-phosphorus pentoxide ratio. As examples we might select the two leafy vegetables that are given below.

*Two leafy vegetables (Table 4) selected to give an average ratio ($CaO:P_2O_5$) of 1 : 3.*

| Sample No. | Local name. | Calcium ($CaO$). | Phosphorus ($P_2O_5$). | Ratio ($CaO:P_2O_5$). |
|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | |
| 19 | Sibuyas | 0.16 | 0.10 | 1 : 0.6 |
| 158 | Kasoy | 0.05 | 0.27 | 1 : 5.4 |

To mix these two vegetables so that the combination will have an average ratio of ($CaO: P_2O_5$) of 1: 3, it is only necessary to take an amount of each sufficient to yield a gram of calcium oxide.

According to the analysis 100 grams of sample 19 contain 0.16 gram of calcium oxide. Therefore, 625 grams of the sample will contain 1 gram of calcium oxide as shown by the following proportion:

$$100: 0.16 = x: 1$$
$$x = 625$$

Calculated in a like manner 2,000 grams of sample 158 will also contain 1 gram of calcium oxide. By mixing these two samples in these proportions the combination will have an average ratio ($CaO: P_2O_5$) of 1: 3, as shown below:

*Combination, by weight, of two leafy vegetables that gives an average ratio ($CaO:P_2O_5$) of 1 : 3.*

| Sample No. | Weight of sample. | Weight of CaO. | Weight of $P_2O_5$. | Average ratio ($CaO:P_2O_5$) for combination. |
|---|---|---|---|---|
| | *g.* | *g.* | *g.* | |
| 19 | 625 | 1 | 0.6 | 1 : 3 |
| 158 | 2,000 | 1 | 5.4 | |

In this case by combining, by weight, approximately one part of sibuyas (sample 19) with three parts of kasoy (sample 158) the combination will have an average ratio ($CaO: P_2O_5$) of about 1: 3.

Combinations of three or more vegetables can be calculated in a similar manner.

For convenience these calculations were based upon fresh samples that contained moisture. Although the moisture content of all the samples was quite high, yet the moisture in individual samples did not, in general, vary more than about 10 per cent from the average moisture content of all the samples analyzed. If the analyses of moisture-free samples are used for the calculations the results obtained are about the same.

Rice is comparatively high in phosphorus and very low in calcium. In countries where the diet of the masses consists largely of rice there is a great tendency for the diet to be unbalanced and to contain an excess of phosphorus. This unbalanced ration may be balanced to a certain extent by including in the diet vegetables that have a high ash content and a relatively large amount of calcareous matter in the ash.

The common names of some vegetables that are frequently sold in the local markets are given in Table 19. These particular vegetables are comparatively high in calcium and low in phosphorus. This unbalanced mineral ratio is just the opposite of that in rice. The addition of these vegetables to a ration consisting largely of rice would tend to balance the calcium-phosphorus ratio in the rice.

*Iron in Philippine food plants.*—Iron is a very important food constituent. It has been estimated that an adult requires about 10 to 12 milligrams of iron in a daily diet that is otherwise adequate in other respects. Lack of iron in the diet causes nutritional anæmia. As reiterated in a note published recently[9] iron, one of the oldest medicines in the world, is still one of the most dependable for certain types of anæmia. The human body is not at all efficient for absorbing and using iron, so that relatively enormous doses have to be used to give an anemic patient the needed benefits. However, there is no danger in the use of iron as it seems to be impossible to administer an overdose.

The general distribution of iron in different groups of Philippine food plants is given below:

| Group of food plants. | Iron ($Fe_2O_3$). Per cent. |
|---|---|
| Leafy vegetables | 0.02 to 0.72 |
| Nonleafy vegetables | 0.002 to 0.14 |
| Fruits | 0.002 to 0.06 |
| Seeds | 0.002 to 0.034 |
| Roots and tubers | 0.003 to 0.07 |

As shown by the data, the leaves of vegetables contain the highest percentage of iron. These leaves also have a high moisture content, but only a very small amount of fat and protein. They are, therefore, especially valuable as a source of iron for they can be added to the diet without greatly increasing the total food consumption.

The common names of some Philippine vegetables having leaves that are rich in iron are given in Table 20. For each sample there is given the number of milligrams of iron ($Fe_2O_3$) contained in 100 grams of the fresh vegetable leaves.

## SUMMARY

A large number of plants and plant products were analyzed for the calcium, phosphorus, and iron contents and also for moisture and total ash.

The samples selected for analysis were classified in accordance with the following groups: Leafy vegetables, nonleafy vegetables, fruits, seeds, and roots, tubers, and rhizomes.

The analytical results obtained indicate that, in general, the leafy vegetables have a relatively high ash content and may be considered excellent sources of calcium, phosphorus, and iron.

Some vegetables with a high ash content had a rather low percentage of phosphorus, calcium, and iron. Others with a comparatively small amount of ash gave a rather high percentage of these mineral elements.

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[9] Science 82 (1935) Supplement.

The phosphorus content of the nonleafy vegetables was about the same as that of the leafy ones but the amount of ash, calcium, and iron was much less.

In general, the mineral constituents of fruits are much lower than those of vegetables. Fruits usually contain somewhat more phosphorus than calcium, but the iron content is particularly low.

Seeds were very low in calcium and iron though the phosphorus was quite high. This abnormal, or unbalanced, proportion of phosphorus and calcium is a characteristic property of seeds, especially noticeable in the case of rice.

Roots and tubers generally have a low ash content and most of them have a very small percentage of iron.

Special tables were prepared in order to make the following information more readily available:

Names of plant materials that are very rich in phosphorus, calcium, or iron.

General distribution of mineral elements in different groups of plants and in different parts of the same plant.

Location and climate in relation to the mineral constituents in leafy vegetables.

The calcium-phosphorus ratio was used to indicate how various vegetables may be combined to get the highest nutritional value in these important mineral elements.

The importance of including vegetables high in calcium in a diet consisting largely of rice was emphasized.

A survey of the general distribution of iron in different groups of Philippine food plants showed that the leafy vegetables contained the highest percentage of iron.

The names of Philippine vegetables having leaves that are rich in iron were recorded together with the number of milligrams of iron ($Fe_2O_3$) contained in 100 grams of the fresh vegetable leaves.

## ACKNOWLEDGMENT

The author desires to express his indebtedness to Dr. A. P. West, chief of the Chemical Research Division, Bureau of Science, for the kind help rendered in this investigation, to Dr. Eduardo Quisumbing, chief of the National Museum Division of the same bureau, for the identification of certain plants used in this investigation, and to Dr. William H. Brown for the collection of some samples analyzed.

TABLE 1.—*Names of Philippine food plants analyzed.*

LEAFY VEGETABLES.

| Sample No. | Name of plant. |  | Part analyzed. | Remarks. |
|---|---|---|---|---|
|  | Scientific. | Common. |  |  |
| 8 | *Allaenthus luzonicus* (Blanco) F.-Vill | Himbaba-6. | Leaves |  |
| 19 | *Allium cepa* L. | Sibuyas | Leaves and bulb |  |
| 60 | *Allium fistulosum* L. | Cibol, spring onion | Leaves and leaf bases |  |
| 57 | *Allium porrum* L. | Leek | do |  |
| 15 | *Allium sativum* L. | Bauang, garlic | do |  |
| 18 | *Allium tuberosum* Roxb. | Kuchai | Leaves |  |
| 159 | *Amaranthus paniculatus* L. | Kudiapa | Leaves and tops |  |
| 182 | *Amaranthus tricolor* L. | Halon | do |  |
| 1 | *Amaranthus viridis* L. | Kolitis | Leaves |  |
| 158 | *Anacardium occidentale* L. | Kasoy, cashew | Young leaves |  |
| 9 | *Apium graveolens* L. | Kinchai | Leaves and petioles |  |
| 58 | *Apium graveolens* L. var. *dulce* DC | Celery, kinchai puti | Petioles | White variety. |
| 20 | *Athyrium esculentum* Copel | Pakó | Leaves |  |
| 11 | *Basella rubra* L. | Libato, alugbati | Leaves and tops |  |
| 16 | *Bauhinia malabarica* Roxb. | Alibangbáng | do |  |
| 48 | *Beta vulgaris* L. | Remolacha, beet | Leaves |  |
| 175 | Do | do | Petioles |  |
| 814 | *Beta vulgaris* L. var. *cicla* L. | Swiss chard | Leaves |  |
| 10 | *Brassica chinensis* L. | Petsai | do |  |
| 6 | *Brassica integrifolia* (West) O. E. Schulz | Mostaza, mustard | do |  |
| 237 | Do | do | do | Chinese mustard. |
| 180 | *Brassica napobrassica* Mill | Rutabaga | do |  |
| 4 | *Brassica oleracea* L. var. *acephala* L. | Koles, kale | do |  |
| 47 | *Brassica oleracea* L. var. *botrytis* DC | Coliflor, cauliflower | Leaves and flower heads |  |
| 211 | Do | do | do | California cauliflower. |
| 25 | *Brassica oleracea* L. var. *capitata* Hort. | Repollo, cabbage | Leaves | Green leaves. |
| 52 | Do | do | do | Red leaves. |
| 819 | *Brassica oleracea* L. var. *gemmifera* Hort. | Brussels sprouts | do |  |

TABLE 1.—*Names of Philippine food plants analyzed*—Continued.

LEAFY VEGETABLES—Continued.

| Sample No. | Name of plant. | | Part analyzed. | Remarks. |
|---|---|---|---|---|
| | Scientific. | Common. | | |
| 49 | ***Brassica oleracea*** **L. var.** ***italica*** **Plench** | Sprouting broccoli | Leaves, tops, and pith of stem | |
| 50 | ***Brassica pekinensis*** **Rupr.** | Wongbok | Leaves | Chinese cabbage. |
| 41 | ***Capsicum frutescens*** **L.** | Siling labuyo | do | |
| 107 | ***Ceiba pentandra*** **(L.) Gaertn.** | Boboy, kapok | Young leaves | |
| 387 | ***Ceratopteris thalictroides*** **(L.) Brongn.** | Water fern | Leaves and tops | |
| 344 | ***Chrysanthemum coronarium*** **L.** | Tunghao | Leaves | |
| 55 | ***Cichorium endivia*** **L.** | Escarola, endive | do | |
| 98 | ***Colocasia esculentum*** **(L.) Schott** | Gabi | Petioles | Chinese variety. |
| 98-A | Do | do | do | Native variety, purple. |
| 98-B | Do | do | do | Native variety, green. |
| 225 | Do | do | Leaves | Native variety. |
| 43 | ***Corchorus olitorius*** **L** | Saluyot | Leaves and tops | |
| 14 | ***Coriandrum sativum*** **L.** | Coriander, ongsoy | Leaves and petioles | |
| 35 | ***Cucurbita maxima*** **Duch.** | Calabaza, squash | Leaves and tops | |
| 36 | ***Gnetum gnemon*** **L.** | Bago | do | |
| 109 | ***Helminthostachys zeylanica*** **(L.) Hook.** | Tukod-langit | do | |
| 29 | ***Ipomoea batatas*** **(L.) Poir** | Kamote, sweet potato | do | |
| 2-A | ***Ipomoea reptans*** **(L.) Poir** | Kangkong, water convulvulus | do | |
| 27 | ***Lactuca sativa*** **L.** | Lechugas, lettuce | Leaves | |
| 166 | Do | do | do | Head lettuce. |
| 329 | ***Limnophila rugosa*** **(Roth.) Merr.** | Tala | do | |
| 320 | ***Manihot utilissima*** **Pohl** | Kamoteng-kahoi, cassava | do | Young leaves only. |
| 117 | ***Mentha arvensis*** **L.** | Yerba buena | Leaves and tops | |
| 21 | ***Mollugo oppositifolia*** **L.** | Malagoso, sarsalida | Leaves | |
| 28 | ***Momordica charantia*** **L.** | Ampalaya, balsam pear | do | Wild form. |
| 331 | ***Momordica cochinchinensis*** **(Lour.) Spreng.** | Buyok-buyok | Leaves and tops | |
| 40 | ***Moringa oleifera*** **Lam.** | Malungai | Leaves | |

| | | | | |
|---|---|---|---|---|
| 321 | *Nymphaea nouchali* Burm. f. | Tunas | Petioles | |
| 23 | *Petroselinum hortense* Hoffm | Perejil, parsley | Leaves | |
| 335 | *Phaseolus calcaratus* Roxb | Capilan | Leaves and tops | |
| 137 | *Phytolacca esculenta* van Houte | Pokeweed | Leaves | |
| 315 | *Plantago major* (L.) var. *asiatica* Decne | Plantain | do | **Japanese variety.** |
| 333 | *Portulaca oleracea* L | Ulasiman, purslane | do | |
| 51 | *Radicula nasturtium-aquaticum* Br. and R | Water cress | Leaves and tops | |
| 8 | *Rheum rhaponticum* L | Garden rhubarb | Petioles | |
| 59 | *Rumex ambiguus* Gren | Indian spinach | Leaves and tops | |
| 132 | *Sechium edule* Sw | Chayote | do | |
| 133 | *Solanum nigrum* L | Amantec | Leaves | |
| 93 | *Spinacia oleracea* L | American spinach | Leaves and petioles | |
| 56 | Do | Prickly-seeded spinach | do | |
| 369 | *Spondias purpurea* L | Ciruelas, cineguelas | Young leaves | |
| 172 | *Tamarindus indica* L | Sampalok, tamarind | do | |
| 46 | *Tetragonia expansa* Thb | New Zealand spinach | Leaves | |
| 119 | *Trianthema portulacastrum* L | Toston, ayam | do | |
| 332 | *Vallisneria gigantea* Graebn | Sinta-sintasan, sabutan-buaia | Young leaves | |
| 89 | *Vigna sesquipedalis* Fruw | Sitao, yard-long bean | Leaves and tops | |

NONLEAFY VEGETABLES.

| | | | | |
|---|---|---|---|---|
| 186 | *Areca catechu* L | Buñga | Stem tip | Cabbage. |
| 201 | *Arenga pinnata* (Wurmb.) Merr | Kaong, kabo negro | do | Do. |
| 269 | *Artocarpus communis* Forst | Rimas, kamansi | Green fruit | |
| 135 | *Asparagus officinalis* L | Esparrago, asparagus | Stem tip | |
| 200 | Do | do | do | California **asparagus.** |
| 205 | *Bambusa spinosa* Roxb | Kauayan toto-o | Shoot | Tender portion. |
| 268 | *Benincasa hispida* (Thunb.) Cogn | Kondol, tibyayong | Fruit | |
| 68 | *Brassica oleracea* L. var. *caulorapa* Hort | Kohlrabi | Stem | |
| 325 | *Canavalia ensiformis* DC | Marutong, batao americano | Young pods | |
| 89 | *Capsicum annum* L. var. *grossum* Sendt | Sili, sweet pepper | Fruit | |
| 151 | *Capsicum frutescens* L | Chileng-bundok, native hot pepper | do | |
| 215 | *Carica papaya* L | Papaya | Green fruit | |

TABLE 1.—*Names of Philippine food plants analyzed*—Continued.

NONLEAFY VEGETABLES—Continued.

| Sample No. | Name of plant. | | Part analyzed. | Remarks. |
|---|---|---|---|---|
| | Scientific. | Common. | | |
| 185 | *Cocos nucifera* L. | Niog, coconut | Stem tip | Tender portion of stem. |
| 62 | *Cucumis sativus* L. | Pepino, cucumber | Fruit | |
| 212 | Do. | do. | do. | White variety. |
| 141 | *Cucurbita maxima* Duch. | Calabasa, squash | do. | Fruit, bottle-shaped form. |
| 142 | Do. | do. | do. | Fruit, elliptical form. |
| 143 | Do. | do. | do. | Fruit, oblong form. |
| 156 | Do. | do. | do. | Fruit, flat and orbicular form. |
| 289 | Do. | do. | do. | Fruit, typical form. |
| 290 | Do. | do. | do. | Fruit, rounded form. |
| 291 | Do. | do. | do. | Common type. |
| 301 | Do. | do. | Flowers | |
| 70 | Do. | Calabasa | Fruit | Summer squash. |
| 280 | *Helianthus tuberosus* L. | Artichoke | Flower heads | |
| 30 | *Dolichos lablab* L. | Batao, sibachi | Young pods | |
| 31 | *Hibiscus esculentus* L. | Okra | Fruit | |
| 37 | *Lagenaria leucantha* (Duch.) Rusby | Upo, kalubai | Green fruit | Fruit, elongated form. |
| 165 | Do. | do. | do. | Fruit, bottle-shaped. |
| 129 | Do. | do. | do. | Chinese variety. |
| 342 | Do. | do. | do. | Japanese variety. |
| 163 | *Luffa cylindrica* (L.) M. Roem. | Patolang bilog | do. | Fruit with rough skin. |
| 164 | Do. | do. | do. | Fruit with smooth skin. |
| 83 | *Lycopersicum esculentum* Mill. | Kamates, tomato | Fruit | American tomato. |
| 152 | Do. | do. | do. | Wild form. |
| 229 | Do. | do. | do. | Native form. |
| 12 | *Momordica charantia* L. | Ampalaya | do. | |

| | | | | |
|---|---|---|---|---|
| 181 | *Moringa oleifera* Lam | Malungai | Young pods | |
| 202 | *Musa errans* (Blanco) Teodoro var. *botoan* Teodoro | Butuan | Heart | |
| 204 | *Musa sapientum* L. var. *compressa* (Blanco) Teodoro | Saba | do | |
| 323 | *Nymphaea nouchali* Burm. f | Tunas | Ovaries | |
| 327 | *Pachyrrhizus erosus* (L.) Urb | Sincamas | Young pods | |
| 85 | *Passiflora quadrangularis* L | Granadilla | Fruit | |
| 26 | *Phaseolus vulgaris* L | Habichuelas | Young pods | Tough pods. |
| 42 | Do | String beans | do | Kentucky string beans. |
| 337 | Do | Dwarf wax beans | do | Chinese beans. |
| 339 | Do | Wonder beans | do | Kentucky beans. |
| 78 | Do | Wax beans | do | White Chinese wax beans. |
| 146 | Do | Bush wax beans | do | |
| 147 | *Phaseolus* sp | Sheeras beans | do | |
| 22 | *Pisum sativum* L | Chicharo, peas | do | Fibrous. |
| 34 | Do | do | do | Soft. |
| 74 | Do | do | do | Chinese peas. |
| 336 | *Psophocarpus tetragonolobus* (L.) DC | Segidilla, cigarillas | do | |
| 71 | *Sechium edule* Sw | Chayote | Fruit | |
| 343 | *Sesbania grandiflora* (L.) Pers | Katuray, gauaigauai | Flowers | |
| 32 | *Solanum melongena* L | Talong morado, eggplant | Fruit | Fruit, obovoid form. |
| 88 | Do | Talong | do | Fruit, elongated form. |
| 257 | Do | do | do | Japanese egg plant. |
| 82 | Do | do | do | |
| 279 | *Tamarindus indica* L | Sampalok, tamarind | Young fruits | |
| 113 | Do | Sampalok | Flowers | |
| 17 | *Vigna sesquipedalis* Fruw | Sitao puti, yard-long bean | Young pods | |
| 45 | Do | Sitao pula, yard-long bean | do | |
| 270 | *Vigna sinensis* (L.) Savi | Paayap, cowpea | do | |
| 271 | *Telosma procumbens* (Blanco) Merr | Bagbagcong | Flowers | |
| 246 | *Allium ascalonicum* L | Shallot | Leaf bases | |
| 245 | *Allium cepa* L | Sibuyas, onion | do | |
| 248 | *Allium sativum* L | Bauang, ajo, garlic | do | |

TABLE 1.—*Names of Philippine food plants analyzed*—Continued.

FRUITS.

| Sample No. | Name of plant. | | Part analyzed. | Remarks. |
|---|---|---|---|---|
| | Scientific. | Common. | | |
| 208 | *Achras zapota* L. | Chico | Pulp | |
| 206 | *Ananas comosus* (L.) Merr. | Piña, pineapple | do | Native. |
| 240 | Do | do | do | Hawaiian, Smooth Cayenne. |
| 155 | Do | do | do | Baguio pineapple. |
| 128 | *Anona glabra* L. | Mamon | do | |
| 238 | *Anona muricata* L. | Guayabano | do | |
| 172 | *Anona squamosa* L. | Ates, custard apple | do | |
| 207 | *Antidesma bunius* (L.) Spreng | Bignai | do | |
| 244 | *Artocarpus integra* (Thunb.) Merr | Nangka, jack fruit | do | |
| 199 | *Averrhoa bilimbi* L. | Kamias | do | |
| 169 | *Averrhoa carambola* L. | Balimbing | do | |
| 273 | *Calocarpum sapota* (Jacq.) Merr. | Chico mamey | do | |
| 239 | *Carica papaya* L. | Papaya | do | Native. |
| 241 | Do | do | do | Hawaiian, rounded form. |
| 242 | Do | do | do | Hawaiian, oblong obovoid form. |
| 94 | *Citrullus vulgaris* Schrad. | Sandia, pakuan, watermelon | do | |
| 184 | *Citrus limonia* Osbeck. | Lemon | do | |
| 102 | *Citrus maxima* (Burm.) Merr. | Lukban, pomelo, grape fruit | do | |
| 252 | *Citrus mitis* Blanco | Kalamansi, calamondin | do | |
| 123 | *Cucumis melo* L. | Melon castila | do | |
| 124 | Do | Melon tagalog | do | |
| 363 | Do | Cantaloupe | do | Black kinalabasa. |
| 364 | Do | do | do | White kinalabasa. |
| 365 | Do | do | do | Black baluga. |
| 366 | Do | do | do | Black valencia. |
| 367 | Do | do | do | Kinastila. |
| 368 | Do | do | do | From Imus, Cavite. |
| 287 | *Citrus aurantium* L | Cajel, dalandan | do | |

| | | | | |
|---|---|---|---|---|
| 298 | *Citrus nobilis* Lour | Naranjita | do | |
| 285 | *Cyphomandra calycina* Sondt | Cyndra | do | |
| 188 | *Decaspermum fruticosum* Forst | Tambis | do | |
| 234 | *Dillenia philipinensis* Rolfe | Catmon | do | |
| 122 | *Diospyros discolor* Willd | Mabolo | do | Red fruit. |
| 169 | Do | do | do | Yellow fruit. |
| 888 | Do | do | do | Seedless. |
| 817 | *Diospyros kaki* L | Sapote | do | Imported from China. |
| 115 | *Eugenia cumini* (L.) Druce | Duhat | do | |
| 167 | *Eugenia javanica* Lam | Makopa | do | |
| 874 | *Eugenia malaccensis* L | Tersana | do | |
| 283 | *Eugenia polycephaloides* C. B. Rob | Lipoti | do | |
| 190 | *Ficus cuernosensis* Elm | Agbay | Pulp and seeds | |
| 187 | *Ficus nota* (Blanco) Merr | Tibig | do | |
| 282 | *Flacourtia ramontchi* L. Herit | Serali | do | |
| 91 | *Fragaria chiloensis* Dch | Strawberry | do | |
| 873 | *Garcinia cochinchinensis* | Garcinia | Pulp | |
| 889 | *Garcinia dulcis* (Roxb.) Kurz | Taklang-anak, banate | do | |
| 381 | *Garcinia mangostana* L | Mangosteen | do | |
| 390 | *Garcinia venulosa* (Blanco) Choisy | Gatasan, katuri | do | |
| 284 | *Garcinia vidalii* Merr | Piris | do | |
| 189 | *Grewia stylocarpa* Warb | Kamuling | do | |
| 324 | *Lansium domesticum* Correa | Lanzones | do | |
| 125 | *Lichi chinensis* Son | Litchi, lechias, lichi | do | Imported from China. |
| 218 | *Mangifera indica* L | Manga, mango | do | Ripe fruit, carabao variety. |
| 219 | Do | do | do | Ripe fruit, pico variety. |
| 222 | *Musa sapientum* L. var. *cinerea* (Blanco) Teodoro | Latundan | do | |
| 223 | *Musa sapientum* L. var. *compressa* (Blanco) Teodoro | Saba | do | |
| 221 | *Musa sapientum* L. var. *lacatan* (Blanco) Teodoro | Lacatan | do | |
| 220 | *Musa sapientum* L. var. *suaveolens* (Blanco) Teodoro | Bungulan | do | |
| 231 | *Musa sapientum* L. var. *ternatensis* (Blanco) Teodoro | Gloria | do | |
| 285 | *Musa sapientum* L. var. *violacea* (Blanco) Teodoro | Morado | do | |

TABLE 1.—*Names of Philippine food plants analyzed*—Continued.

FRUITS—Continued.

| Sample No. | Name of plant. | | Part analyzed. | Remarks. |
|---|---|---|---|---|
| | Scientific. | Common. | | |
| 138 | *Morus alba* L. | Mulberry | Pulp and seeeds | |
| 114 | *Nephelium mutabile* Blanco | Bulala | Pulp | |
| 64 | *Passiflora alba* | Passiflora alba | Pulp and seeds | |
| 161 | *Passiflora edulis* Sims | Lilikoi, purple-fruited passion flower | do | |
| 65 | *Passiflora mollisima* L. H. Bailey | Passiflora mollisima | do | |
| 210 | *Psidium guajava* L. | Guava | do | |
| 265 | *Persea americana* Mill | Avocado | Flesh | |
| 227 | *Punica granatum* L. | Granada | Pulp and seeds | |
| 243 | *Pyrus communis* L. | Pear | Pulp | Imported from China. |
| 805 | *Pyrus malus* L. | Apple | do | Green-colored fruit; imported from China. |
| 306 | Do | do | do | Green-colored fruit; imported from U. S. A. |
| 170 | *Sandoricum koetjape* (Burm. f.) Merr. | Santol | do | |
| 313 | *Spondias lutea* Merr. | Mombin | do | |
| 391 | *Spondias cytheria* Son | Hevi | do | |
| 116 | *Spondias purpurea* L. | Ciruelas, cineguelas | do | |
| 194 | *Scindapsus hederaceus* Schott | Putoputuhan | do | |
| 281 | *Tamarindus indica* L. | Sampalok, tamarind | do | |
| 121 | *Prunus persica* Sieb and Zuce | Peach | do | Imported from China. |
| 196 | *Prunus americana* Marsh | Plum | do | Imported from U. S. A. |
| 228 | *Prunus triflora* Roxb | do | do | Imported from China. |
| 197 | *Prunus* sp. | Sweet cherry | do | |
| 195 | *Prunus armeniaca* L. | Common apricot | Pulp and seeds | |
| 275 | *Uvaria alba* Merr | Susong calabao | do | |
| 100 | *Vaccinium myrtoides* (Bl.) Miq. | Baguio blueberry, gatmo | do | |
| 348 | *Zizyphus jujuba* (L.) Lam. | Manzanitas | Pulp | Native. |
| 318 | *Zizyphus* sp. | do | do | Imported from China. |

## SEEDS.

| | | | | |
|---|---|---|---|---|
| 356 | *Anacardium occidentale* L. | Kasoy, cashew | Mature seeds | |
| 276 | *Arachis hypogaea* L. | Mani, peanut | do | Native variety. |
| 277 | Do | do | do | Chinese variety. |
| 247 | *Artocarpus integra* (Thunb.) Merr | Nangka, jack fruit | do | |
| 224 | *Barringtonia acutangula* (L.) Gaertn | Putat | do | |
| 362 | *Cajanus cajan* (L.) Millsp | Kadios | do | |
| 297 | *Canarium luzonicum* (Blanco) A. Gray | Pili | do | |
| 514 | *Coix lachryma-jobi* L. | Ilas, adlay | do | |
| 249 | *Cocos nucifera* L. | Buku | Young nut | |
| 250 | Do | Niog, coconut | Mature nut | |
| 251 | Do | Macapuno | do | |
| 358 | *Glycine max* (L.) Merr | Soy bean | Mature seeds | |
| 261 | Do | Soy bean sprouts | do | |
| 322 | *Nymphaea nouchali* Burm. f | Lauas, tunas | Young seeds | |
| 80 | *Pisum sativum* L. | Chicharo, sweet peas | do | |
| 351 | *Phaseolus aureus* Roxb | Mungo, mung bean | Mature seeds | Green-colored seeds. |
| 173 | Do | Taogui (mungo sprouts) | Seed sprouts | One day old, radicle and plumule 2 to 3 mm. |
| 174 | Do | do | do | Two days old, radicle 10 to 15 mm long. |
| 174-A | Do | do | do | Three to four days old, radicle 20 to 30 mm long. |
| 148 | *Phaseolus* sp. | Sheeras bean | Young seeds | |
| 350 | Do | Mungo | Mature seeds | Red seeds. |
| 360-A | *Phaseolus lunatus* L. | Patani, cowpea | do | |
| 361 | *Phaseolus aureus* Roxb | Mungo | do | Yellow seeds. |
| 363 | *Oryza sativa* L. | Bigas (rice) | do | Ramai variety. |
| 363-A | Do | Tikitiki | Rice bran | |
| 235 | *Zea mays* L. | Maiz, corn | Young seeds | Yellow seeds. |
| 357 | Do | do | Mature seeds | Do. |
| 236 | Do | do | Young seeds | White seeds. |
| 278 | *Vigna sinensis* (L.) Savi | Sitao, balatong | do | |
| 359 | *Junglas regia* L. | Nuez, English walnut | Mature nuts | |

TABLE 1.—*Names of Philippine food plants analyzed*—Continued.

ROOTS, TUBERS, AND RHIZOMES.

| Sample No. | Name of plant. |  | Part analyzed. | Remarks. |
|---|---|---|---|---|
|  | Scientific. | Common. |  |  |
| 53 | *Beta vulgaris* L. | Remolacha, beet | Root |  |
| 262 | Do | do | do | Chinese beet. |
| 263 | Do | do | do | American beet. |
| 101 | *Brassica napobrassica* Mill | Rutabaga | do |  |
| 232 | Do | do | do | Imported from U. S. A. |
| 264 | *Brassica rapa* L. | Turnip | do | Baguio turnip, round form. |
| 316 | Do | do | do |  |
| 86 | *Colocasia esculentum* (L.) Schott | Gabi | Tuber | Native gabi. |
| 307 | Do | do | do | Chinese gabi. |
| 213 | *Curcuma longa* (L.) Schott | Dilaw, turmeric | Rhizome |  |
| 81 | *Daucus carota* (L.) | Carrot | Root |  |
| 254 | Do | do | do | Chinese carrot. |
| 258 | Do | do | do | American carrot. |
| 345 | Do | do | do | Japanese carrot. |
| 347 | *Dioscorea alata* (L.) | Ube | Tuber |  |
| 193 | *Dioscorea hispida* Dennst | Nami | Root |  |
| 127 | *Eleocharis dulcis* (Burm. f.) Trin | Apulid, water chestnut | Rhizome | Native variety. |
| 126 | *Eleocharis* sp | Chinese water chestnut | do | Chinese variety. |
| 154 | *Ipomoea batatas* (L.) Poir | Kamote, sweet potato | Root | White skin, red within. |
| 179 | Do | do | do | Red skin, white within. |
| 177 | Do | do | do | White skin, yellow within. |
| 176 | Do | do | do | Pink skin, yellow within. |
| 178 | Do | do | do | White skin, white within. |
| 183 | Do | do | do | Baguio sweet potato. |
| 308 | Do | do | do | Chinese sweet potato. |

| | | | | |
|---|---|---|---|---|
| 87 | *Pachyrrhizus erosus* (L.) Urb | Sincamas | do | |
| 54 | *Pastinaca sativa* L | Parsnip | do | |
| 259 | Do | do | do | American variety. |
| 63 | *Raphanus sativus* L | Rabanos, radish | do | |
| 61 | Do | do | do | Red-colored skin. |
| 346 | Do | do | do | Japanese variety. |
| 69 | *Solanum tuberosum* L | Patatas, potato | Tuber | Japanese potato. |
| 157 | Do | do | do | Benguet potato. |
| 214 | *Zingiber officinale* Roscoe | Luya, ginger | Rhizome | |
| 310 | Do | do | do | Chinese ginger. |

TABLE 2.—*Analysis of the ash of plant materials (with and without fusion with sodium carbonate).*

| Sample No. | Treatment with or without sodium carbonate. | Phosphorus ($P_2O_5$). | Calcium (CaO). | Iron ($Fe_2O_3$). |
|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* |
| 10 | Fused | 9.56 | 25.52 | 0.81 |
| 10 | Not fused | 9.47 | 25.01 | 0.72 |
| 47-A | Fused | 14.42 | 4.96 | 1.29 |
| 47-A | Not fused | 14.08 | 4.89 | 1.15 |
| 3 | Fused | 5.58 | 31.33 | 0.45 |
| 3 | Not fused | 5.56 | 30.94 | 0.43 |

TABLE 3.—*Phosphoric anhydride in moisture-free samples ashed with and without magnesium nitrate solution.*

| Sample No. | Treatment. | Phosphorus ($P_2O_5$). |
|---|---|---|
| | | *Per cent.* |
| 22 | With magnesium nitrate | 1.76 |
| 22 | Without magnesium nitrate | 1.74 |
| 52 | With magnesium nitrate | 1.19 |
| 52 | Without magnesium nitrate | 1.14 |

TABLE 4.—*The phosphorus, calcium, and iron contents of leafy vegetables and the corresponding calcium oxide-phosphorus pentoxide ratio of each.*

| Sample No. | Common name of plant. | Moisture. | Ash in— |  | Phosphorus ($P_2O_5$) in— |  |  | Calcium (CaO) in— |  |  | Iron ($Fe_2O_3$) in— |  |  | Ratio $CaO:P_2O_5$. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Fresh sample. | Moisture-free sample. | Fresh sample. | Moisture-free sample. | Ash. | Fresh. sample. | Moisture-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. |  |
|  |  | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |  |
| 8 | Himbaba-ó | 74.00 | 2.88 | 11.08 | 0.38 | 1.47 | 13.24 | 0.41 | 1.59 | 14.35 | 0.030 | 0.12 | 1.05 | 1:0.9 |
| 19 | Sibuyas | 90.15 | 0.90 | 9.16 | 0.10 | 1.00 | 10.86 | 0.16 | 1.61 | 17.61 | 0.011 | 0.11 | 1.20 | 1:0.6 |
| 60 | Cibol | 87.96 | 1.18 | 9.73 | 0.07 | 0.54 | 5.56 | 0.22 | 1.84 | 18.92 | 0.010 | 0.08 | 0.82 | 1:0.3 |
| 57 | Leek | 90.66 | 0.78 | 8.31 | 0.11 | 1.18 | 14.19 | 0.10 | 1.03 | 12.35 | 0.005 | 0.06 | 0.67 | 1:1.1 |
| 15 | Bauang | 91.01 | 1.24 | 13.78 | 0.16 | 1.83 | 13.25 | 0.13 | 1.43 | 10.36 | 0.007 | 0.08 | 0.58 | 1:1.2 |
| 18 | Kuchai | 90.97 | 1.45 | 16.09 | 0.16 | 1.74 | 10.81 | 0.14 | 1.55 | 9.61 | 0.012 | 0.14 | 0.86 | 1:1.1 |
| 159 | Kudiapa | 85.36 | 2.74 | 18.69 | 0.21 | 1.40 | 7.47 | 0.52 | 3.57 | 19.10 | 0.009 | 0.06 | 0.32 | 1:0.4 |
| 182 | Halon | 88.51 | 2.20 | 19.18 | 0.19 | 1.65 | 8.59 | 0.32 | 2.82 | 14.71 | 0.017 | 0.15 | 0.77 | 1:0.6 |
| 1 | Kolitis | 89.13 | 2.10 | 19.64 | 0.21 | 1.99 | 10.11 | 0.39 | 3.63 | 18.50 | 0.045 | 0.42 | 2.16 | 1:0.5 |
| 158 | Kasoy | 74.30 | 1.10 | 4.28 | 0.27 | 1.03 | 24.11 | 0.05 | 0.18 | 4.11 | 0.025 | 0.10 | 2.29 | 1:5.4 |
| 9 | Kinchai | 86.00 | 2.06 | 14.71 | 0.16 | 1.12 | 7.61 | 0.34 | 2.45 | 16.63 | 0.015 | 0.11 | 0.74 | 1:0.5 |
| 58 | Celery, kinchai puti | 94.13 | 0.84 | 14.36 | 0.10 | 1.74 | 12.11 | 0.06 | 1.09 | 7.57 | 0.003 | 0.05 | 0.36 | 1:1.6 |
| 20 | Pakó | 89.98 | 1.32 | 13.15 | 0.26 | 2.56 | 19.46 | 0.03 | 0.25 | 1.89 | 0.006 | 0.06 | 0.47 | 1:10.2 |
| 11 | Libáto | 90.50 | 1.53 | 16.08 | 0.14 | 1.51 | 9.37 | 0.32 | 3.33 | 20.68 | 0.017 | 0.18 | 1.09 | 1:0.5 |
| 16 | Alibangbang | 81.84 | 1.02 | 5.63 | 0.18 | 1.01 | 17.96 | 0.06 | 0.37 | 6.50 | 0.014 | 0.08 | 1.37 | 1:2.7 |
| 48 | Remolacha | 87.91 | 2.71 | 22.40 | 0.15 | 1.27 | 5.65 | 0.38 | 3.17 | 14.15 | 0.035 | 0.27 | 1.22 | 1:0.4 |
| 175 | Do | 96.03 | 0.83 | 21.01 | 0.05 | 1.28 | 6.10 | 0.02 | 0.52 | 2.49 | 0.006 | 0.14 | 0.68 | 1:2.4 |
| 314 | Swiss chard | 91.03 | 1.82 | 20.27 | 0.07 | 0.73 | 3.58 | 0.28 | 3.14 | 15.49 | 0.013 | 0.15 | 0.72 | 1:0.1 |
| 10 | Petsai | 93.63 | 1.16 | 18.20 | 0.11 | 1.74 | 9.56 | 0.30 | 4.65 | 25.52 | 0.009 | 0.15 | 0.81 | 1:0.4 |
| 6 | Mostaza | 91.01 | 1.43 | 15.96 | 0.20 | 2.22 | 13.93 | 0.22 | 2.47 | 15.50 | 0.015 | 0.18 | 1.14 | 1:0.9 |
| 237 | Do | 90.81 | 1.74 | 18.94 | 0.17 | 1.90 | 10.05 | 0.30 | 3.30 | 17.42 | 0.020 | 0.22 | 1.17 | 1:0.6 |
| 180 | Rutabaga | 88.66 | 1.33 | 11.77 | 0.24 | 2.12 | 18.04 | 0.34 | 2.97 | 25.27 | 0.023 | 0.20 | 1.69 | 1:0.7 |
| 4 | Koles | 88.79 | 1.85 | 16.54 | 0.19 | 1.67 | 10.07 | 0.56 | 5.04 | 30.47 | 0.016 | 0.14 | 0.87 | 1:0.3 |
| 47 | Coliflor | 92.24 | 1.07 | 13.81 | 0.16 | 2.02 | 14.66 | 0.08 | 1.00 | 7.26 | 0.003 | 0.04 | 0.30 | 1:2.0 |
| 211 | Do | 90.74 | 1.07 | 11.62 | 0.18 | 1.95 | 16.80 | 0.07 | 0.71 | 6.15 | 0.002 | 0.03 | 0.25 | 1:2.7 |

TABLE 4.—*The phosphorus, calcium, and iron contents of leafy vegetables and the corresponding calcium oxide-phosphorus pentoxide ratio of each*—Continued.

| Sample No. | Common name of plant. | Moisture. | Ash in— | | Phosphorus ($P_2O_5$) in— | | | Calcium (CaO) in— | | | Iron ($Fe_2O_3$) in— | | | Ratio $CaO:P_2O_5$. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fresh sample. | Moisture-free sample. | Fresh sample. | Mois-cure-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. | |
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | |
| **25** | Repollo | 92.09 | 0.67 | 8.42 | 0.08 | 0.94 | 11.19 | 0.07 | 0.92 | 10.93 | 0.002 | 0.03 | 0.36 | 1:1.0 |
| **52** | Do | 92.89 | 0.74 | 10.39 | 0.10 | 1.42 | 13.62 | 0.07 | 1.01 | 9.71 | 0.002 | 0.03 | 0.26 | 1:1.4 |
| **319** | Brussels sprouts | 91.20 | 0.88 | 9.96 | 0.11 | 1.23 | 12.34 | 0.06 | 0.65 | 6.49 | 0.002 | 0.03 | 0.25 | 1:1.9 |
| **49** | Sprouting broccoli | 91.22 | 1.49 | 16.76 | 0.22 | 2.45 | 14.62 | 0.15 | 1.65 | 9.87 | 0.003 | 0.03 | 0.19 | 1:1.5 |
| **50** | Wongbok | 96.80 | 0.52 | 16.34 | 0.08 | 2.58 | 15.77 | 0.04 | 1.33 | 8.14 | 0.001 | 0.04 | 0.27 | 1:1.9 |
| **41** | Siling labuyo | 81.11 | 2.73 | 14.45 | 0.21 | 1.11 | 7.71 | 0.43 | 2.27 | 15.69 | 0.021 | 0.11 | 0.76 | 1:0.5 |
| **107** | Boboy, kapok | 80.02 | 2.04 | 10.21 | 0.23 | 1.16 | 11.38 | 0.41 | 2.04 | 20.00 | 0.013 | 0.07 | 0.65 | 1:0.6 |
| **387** | Water fern | 69.53 | 4.97 | 16.31 | 0.55 | 1.79 | 11.10 | 0.02 | 0.08 | 0.48 | 0.012 | 0.05 | 0.24 | 1:23 |
| **344** | Tung-hao | 93.82 | 1.12 | 18.17 | 0.06 | 1.02 | 5.62 | 0.08 | 1.27 | 7.00 | 0.025 | 0.41 | 2.23 | 1:0.8 |
| **55** | Escarola | 91.56 | 1.65 | 19.56 | 0.10 | 1.24 | 6.35 | 0.16 | 1.89 | 9.67 | 0.008 | 0.10 | 0.49 | 1:0.7 |
| **98** | Gabi | 93.09 | 1.42 | 20.58 | 0.14 | 2.05 | 9.95 | 0.25 | 3.69 | 17.92 | 0.008 | 0.12 | 0.57 | 1:0.6 |
| **98–A** | Do | 93.15 | 1.64 | 23.95 | 0.15 | 2.15 | 8.97 | 0.09 | 1.29 | 5.39 | 0.004 | 0.06 | 0.26 | 1:1.7 |
| **98–B** | Do | 92.70 | 1.40 | 19.24 | 0.12 | 1.65 | 8.56 | 0.10 | 1.43 | 7.42 | 0.006 | 0.08 | 0.44 | 1:1.2 |
| **225** | Do | 78.09 | 2.96 | 13.51 | 0.26 | 1.19 | 8.81 | 0.49 | 2.22 | 16.45 | 0.023 | 0.10 | 0.77 | 1:0.5 |
| **43** | Saluyot | 81.80 | 2.66 | 14.61 | 0.35 | 1.89 | 12.97 | 0.47 | 2.59 | 17.74 | 0.013 | 0.07 | 0.50 | 1:0.7 |
| **14** | Coriander | 86.77 | 1.41 | 10.69 | 0.15 | 1.16 | 10.81 | 0.34 | 2.56 | 23.91 | 0.016 | 0.12 | 1.15 | 1:0.5 |
| **35** | Calabaza | 85.67 | 2.49 | 17.34 | 0.30 | 2.06 | 11.90 | 0.33 | 2.31 | 13.32 | 0.062 | 0.43 | 2.50 | 1:0.9 |
| **36** | Bago | 81.90 | 1.33 | 7.33 | 0.24 | 1.33 | 18.18 | 0.11 | 0.60 | 8.12 | 0.010 | 0.05 | 0.74 | 1:2.2 |
| **109** | Tukod-langit | 85.61 | 1.51 | 10.49 | 0.34 | 2.33 | 22.25 | 0.03 | 0.24 | 2.25 | 0.015 | 0.10 | 0.99 | 1:9.7 |
| **29** | Kamote | 83.96 | 1.64 | 10.21 | 0.15 | 0.96 | 9.41 | 0.13 | 0.78 | 7.64 | 0.020 | 0.13 | 1.24 | 1:1.2 |
| **2–A** | Kangkong | 88.92 | 1.39 | 12.59 | 0.22 | 1.84 | 15.89 | 0.09 | 0.83 | 6.55 | 0.014 | 0.13 | 1.00 | 1:2.2 |
| **27** | Lechugas | 92.98 | 1.23 | 17.55 | 0.11 | 1.60 | 9.14 | 0.19 | 2.78 | 15.85 | 0.020 | 0.28 | 1.61 | 1:0.6 |
| **166** | Do | 96.94 | 0.49 | 16.09 | 0.06 | 1.90 | 11.82 | 0.03 | 1.12 | 6.96 | 0.006 | 0.19 | 1.15 | 1:1.7 |
| **329** | Tala | 88.26 | 2.10 | 17.89 | 0.15 | 1.25 | 7.01 | 0.31 | 2.65 | 14.80 | 0.022 | 0.10 | 0.58 | 1:0.5 |
| **320** | Kamoteng-kahoi | 84.95 | 1.39 | 9.35 | 0.26 | 1.71 | 18.46 | 0.05 | 0.34 | 3.65 | 0.011 | 0.07 | 0.77 | 1:5.0 |
| **117** | Yerba buena | 88.02 | 1.50 | 12.51 | 0.14 | 1.14 | 9.13 | 0.24 | 2.02 | 16.11 | 0.042 | 0.35 | 2.78 | 1:0.6 |
| **21** | Malagoso | 91.65 | 1.50 | 17.97 | 0.10 | 1.14 | 6.34 | 0.11 | 1.33 | 7.39 | 0.030 | 0.35 | 1.97 | 1:0.9 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | Ampalaya | 86.48 | 2.54 | 18.77 | 0.19 | 1.37 | 7.32 | 0.59 | 4.36 | 23.23 | 0.064 | 0.47 | 2.52 | 1:0.3 |
| 331 | Buyok-buyok | 81.62 | 1.38 | 7.50 | 0.30 | 1.62 | 21.61 | 0.09 | 0.46 | 6.19 | 0.014 | 0.07 | 0.99 | 1:3.5 |
| 40 | Malungai | 79.19 | 2.84 | 13.64 | 0.24 | 1.16 | 8.52 | 0.72 | 3.47 | 25.42 | 0.108 | 0.52 | 3.82 | 1:0.3 |
| 321 | Tunas | 97.45 | 0.57 | 22.17 | 0.05 | 1.85 | 8.34 | 0.07 | 0.26 | 1.16 | 0.004 | 0.15 | 0.67 | 1:7.0 |
| 23 | Perejil | 82.56 | 2.77 | 15.90 | 0.23 | 1.29 | 8.12 | 0.49 | 2.79 | 17.55 | 0.039 | 0.23 | 1.42 | 1:0.5 |
| 335 | Kapilan | 86.44 | 1.60 | 11.50 | 0.22 | 1.56 | 13.53 | 0.22 | 1.60 | 13.88 | 0.014 | 0.10 | 0.86 | 1:1.0 |
| 137 | Pokeweed | 83.91 | 2.39 | 14.87 | 0.21 | 1.28 | 8.60 | 0.20 | 1.26 | 8.47 | 0.013 | 0.08 | 0.55 | 1:1.0 |
| 315 | Japanese plantain | 86.16 | 2.09 | 15.08 | 0.15 | 1.07 | 7.07 | 0.53 | 3.86 | 25.58 | 0.024 | 0.17 | 1.15 | 1:0.3 |
| 333 | Ulasiman | 93.27 | 1.60 | 23.75 | 0.11 | 1.67 | 7.03 | 0.16 | 2.31 | 9.74 | 0.007 | 0.10 | 0.42 | 1:0.7 |
| 51 | Water cress | 92.30 | 1.19 | 15.51 | 0.16 | 2.13 | 13.75 | 0.14 | 1.83 | 11.78 | 0.015 | 0.20 | 1.27 | 1:1.2 |
| 3 | Garden rhubarb | 90.08 | 1.78 | 17.97 | 0.10 | 1.00 | 5.58 | 0.56 | 5.63 | 31.33 | 0.008 | 0.08 | 0.45 | 1:0.2 |
| 59 | Indian spinach | 88.94 | 2.75 | 24.82 | 0.20 | 1.82 | 7.34 | 0.17 | 1.49 | 6.02 | 0.013 | 0.12 | 0.48 | 1:1.2 |
| 132 | Chayote | 98.06 | 0.29 | 14.74 | 0.06 | 3.01 | 20.45 | 0.02 | 0.90 | 6.09 | 0.002 | 0.09 | 0.61 | 1:3.3 |
| 133 | Amantec | 84.75 | 1.84 | 12.08 | 0.19 | 1.23 | 10.15 | 0.56 | 3.68 | 30.45 | 0.009 | 0.06 | 0.48 | 1:0.3 |
| 93 | American spinach | 91.15 | 2.41 | 27.29 | 0.14 | 1.62 | 5.93 | 0.13 | 1.47 | 5.38 | 0.063 | 0.72 | 2.63 | 1:1.1 |
| 56 | Prickly-seeded spinach | 86.19 | 3.34 | 24.21 | 0.29 | 2.11 | 8.70 | 0.35 | 2.54 | 10.51 | 0.017 | 0.13 | 0.52 | 1:0.8 |
| 369 | Ciruelas | 75.12 | 1.79 | 7.20 | 0.23 | 0.92 | 12.73 | 0.54 | 2.18 | 30.21 | 0.013 | 0.05 | 0.73 | 1:0.4 |
| 172 | Sampalok | 82.80 | 0.77 | 4.50 | 0.21 | 1.21 | 26.85 | 0.04 | 0.22 | 4.89 | 0.004 | 0.02 | 0.47 | 1:5.5 |
| 46 | New Zealand spinach | 91.13 | 2.52 | 28.46 | 0.12 | 1.54 | 5.42 | 0.11 | 1.41 | 4.94 | 0.037 | 0.47 | 1.66 | 1:1.1 |
| 119 | Toston | 89.36 | 2.66 | 24.99 | 0.17 | 1.60 | 6.39 | 0.15 | 1.38 | 5.52 | 0.067 | 0.63 | 2.51 | 1:1.1 |
| 332 | Sintas-sintasan | 92.19 | 1.12 | 14.38 | 0.25 | 3.15 | 21.94 | 0.09 | 1.21 | 8.42 | 0.011 | 0.15 | 1.02 | 1:2.6 |
| 39 | Sitao | 88.08 | 1.79 | 15.05 | 0.27 | 2.27 | 15.09 | 0.28 | 2.33 | 15.48 | 0.014 | 0.12 | 0.77 | 1:1.0 |

TABLE 5.—*Distribution of leafy vegetables according to the ash, phosphorus, calcium, and iron contents.*[a]

| Ash. | Samples analyzed. | Phosphorus pentoxide. | Samples analyzed. | Calcium oxide. | Samples analyzed. | Ferric oxide. | Samples analyzed. |
|---|---|---|---|---|---|---|---|
| *Per cent.* | | *Per cent.* | | *Per cent.* | | *Per cent.* | |
| 2.81- 5.00 | 2 | 0.54-1.00 | 7 | 0.02-0.10 | 1 | 0.01-0.10 | 35 |
| 5.01-10.00 | 10 | 1.01-1.50 | 27 | 0.11-1.00 | 17 | 0.11-0.19 | 23 |
| 10.01-15.00 | 24 | 1.51-2.00 | 25 | 1.01-2.00 | 24 | 0.20-0.29 | 6 |
| 15.01-20.00 | 26 | 2.01-2.50 | 11 | 2.01-3.00 | 18 | 0.30-0.39 | 2 |
| 20.01-25.00 | 10 | 2.50-3.00 | 2 | 3.01-4.00 | 10 | 0.40-0.49 | 5 |
| 25.01-28.46 | 2 | 3.01-3.15 | 2 | 4.01-5.63 | 4 | 0.50-0.72 | 3 |

[a] Percentages are based on the moisture-free samples.

TABLE 6.—*Phosphorus, calcium, and iron contents of the nonleafy vegetables and the corresponding calcium oxide-phosphorus pentoxide ratio of each.*

| Sample No. | Common name of plant. | Moisture. | Ash in— |  | Phosphorus ($P_2O_5$) in— |  |  | Calcium (CaO) in— |  |  | Iron ($Fe_2O_3$) in— |  |  | Ratio $CaO:P_2O_5$. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Fresh sample. | Moisture-free sample. | Fresh sample. | Moisture-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. |  |
|  |  | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |  |
| 186 | Buñga | 91.48 | 1.23 | 14.44 | 0.17 | 1.94 | 13.42 | 0.03 | 0.39 | 2.72 | 0.003 | 0.04 | 0.27 | 1:4.9 |
| 201 | Kábo-négro | 91.73 | 0.19 | 2.34 | 0.01 | 0.16 | 6.80 | 0.02 | 0.29 | 12.41 | 0.001 | 0.02 | 0.74 | 1:0.6 |
| 269 | Rimas | 89.52 | 0.13 | 1.27 | 0.02 | 0.18 | 14.35 | 0.01 | 0.12 | 9.24 | 0.0002 | 0.002 | 0.14 | 1:1.6 |
| 135 | Espárrago | 94.15 | 0.74 | 12.57 | 0.15 | 2.60 | 20.70 | 0.02 | 0.28 | 2.21 | 0.009 | 0.14 | 1.15 | 1:9.4 |
| 200 | Do | 95.36 | 0.63 | 13.52 | 0.11 | 2.45 | 18.09 | 0.01 | 0.30 | 2.22 | 0.002 | 0.04 | 0.31 | 1:8.1 |
| 205 | Kauayan toto-o | 92.10 | 0.84 | 10.67 | 0.17 | 2.12 | 19.87 | 0.03 | 0.36 | 3.42 | 0.002 | 0.02 | 0.19 | 1:5.8 |
| 268 | Kondol | 96.62 | 0.51 | 15.05 | 0.06 | 1.74 | 11.59 | 0.04 | 1.26 | 8.35 | 0.002 | 0.05 | 0.35 | 1:1.4 |
| 68 | Kohlrabi | 93.69 | 0.96 | 15.14 | 0.12 | 1.92 | 12.69 | 0.05 | 0.80 | 5.28 | 0.004 | 0.06 | 0.43 | 1:2.4 |
| 325 | Marutong | 88.94 | 0.60 | 5.39 | 0.08 | 0.69 | 12.80 | 0.06 | 0.57 | 10.56 | 0.003 | 0.03 | 0.57 | 1:1.2 |
| 89 | Sili | 93.74 | 0.59 | 9.39 | 0.09 | 1.38 | 14.72 | 0.03 | 0.54 | 5.71 | 0.006 | 0.09 | 0.97 | 1:2.6 |
| 151 | Chileng-bundok | 90.57 | 0.77 | 8.12 | 0.12 | 1.25 | 15.37 | 0.03 | 0.35 | 4.27 | 0.003 | 0.04 | 0.44 | 1:3.6 |
| 215 | Papaya | 93.65 | 0.52 | 8.12 | 0.08 | 1.30 | 15.96 | 0.07 | 1.14 | 14.03 | 0.002 | 0.03 | 0.32 | 1:1.1 |
| 185 | Nióg | 89.04 | 1.95 | 17.80 | 0.23 | 2.06 | 11.59 | 0.16 | 1.43 | 8.04 | 0.004 | 0.04 | 0.20 | 1:1.4 |
| 62 | Pepino | 96.96 | 0.48 | 15.81 | 0.08 | 2.73 | 17.27 | 0.04 | 1.21 | 7.64 | 0.002 | 0.06 | 0.35 | 1:2.3 |
| 212 | Do | 97.29 | 0.43 | 15.71 | 0.03 | 1.00 | 6.36 | 0.02 | 0.86 | 5.48 | 0.001 | 0.04 | 0.24 | 1:1.2 |
| 141 | Calabasa | 83.48 | 1.65 | 9.96 | 0.18 | 1.08 | 10.83 | 0.07 | 0.43 | 4.34 | 0.009 | 0.06 | 0.58 | 1:2.5 |
| 142 | Do | 93.54 | 0.89 | 13.73 | 0.12 | 1.78 | 12.94 | 0.05 | 0.82 | 5.94 | 0.001 | 0.02 | 0.12 | 1:2.2 |
| 143 | Do | 91.23 | 1.59 | 18.15 | 0.27 | 3.06 | 16.88 | 0.05 | 0.56 | 3.07 | 0.003 | 0.03 | 0.19 | 1:5.5 |
| 156 | Do | 79.35 | 0.84 | 4.05 | 0.11 | 0.55 | 13.55 | 0.03 | 0.13 | 3.20 | 0.002 | 0.01 | 0.29 | 1:4.2 |
| 289 | Do | 91.20 | 0.62 | 7.03 | 0.07 | 0.85 | 12.07 | 0.02 | 0.22 | 3.08 | 0.001 | 0.01 | 0.14 | 1:3.9 |
| 290 | Do | 86.19 | 1.05 | 7.61 | 0.14 | 1.00 | 13.15 | 0.02 | 0.14 | 1.81 | 0.002 | 0.01 | 0.17 | 1:7.3 |
| 291 | Do | 86.21 | 1.25 | 9.06 | 0.15 | 1.06 | 11.71 | 0.06 | 0.40 | 4.44 | 0.002 | 0.01 | 0.16 | 1:2.6 |
| 301 | Do | 79.58 | 3.41 | 16.70 | 0.58 | 2.86 | 17.10 | 0.21 | 1.05 | 6.30 | 0.02 | 0.12 | 0.73 | 1:2.7 |
| 70 | Do | 95.44 | 0.63 | 13.82 | 0.09 | 2.07 | 15.00 | 0.06 | 1.32 | 9.55 | 0.002 | 0.04 | 0.26 | 1:1.6 |
| 280 | Artichoke | 84.73 | 0.49 | 2.62 | 0.09 | 0.49 | 18.67 | 0.01 | 0.08 | 2.98 | 0.001 | 0.01 | 0.20 | 1:6.3 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | Batao | 90.02 | 0.69 | 6.87 | 0.12 | 1.22 | 17.72 | 0.05 | 0.51 | 7.41 | 0.003 | 0.03 | 0.38 | 1:2.4 |
| 31 | Okra | 88.99 | 0.80 | 7.31 | 0.14 | 1.27 | 17.31 | 0.09 | 0.90 | 12.26 | 0.002 | 0.02 | 0.31 | 1:1.4 |
| 37 | Upo | 95.89 | 0.54 | 13.23 | 0.03 | 0.81 | 6.16 | 0.05 | 1.11 | 8.42 | 0.003 | 0.07 | 0.52 | 1:0.7 |
| 165 | Do | 97.07 | 0.38 | 12.81 | 0.02 | 0.70 | 5.47 | 0.02 | 0.54 | 4.25 | 0.005 | 0.18 | 1.41 | 1:1.3 |
| 129 | Do | 96.06 | 0.54 | 13.73 | 0.07 | 1.84 | 13.38 | 0.03 | 0.80 | 5.80 | 0.002 | 0.05 | 0.35 | 1:2.3 |
| 342 | Do | 97.67 | 0.30 | 13.06 | 0.07 | 3.12 | 23.89 | 0.03 | 1.29 | 9.85 | 0.001 | 0.04 | 0.32 | 1:2.4 |
| 163 | Patolang bilog | 95.99 | 0.60 | 14.89 | 0.12 | 2.96 | 19.90 | 0.03 | 0.64 | 4.32 | 0.004 | 0.09 | 0.62 | 1:4.6 |
| 164 | Do | 95.36 | 0.63 | 13.50 | 0.11 | 2.39 | 17.71 | 0.04 | 0.81 | 6.01 | 0.003 | 0.06 | 0.41 | 1:2.9 |
| 83 | Kamates | 94.62 | 0.57 | 10.54 | 0.05 | 0.94 | 8.91 | 0.01 | 0.31 | 2.91 | 0.003 | 0.06 | 0.54 | 1:3.1 |
| 152 | Do | 93.41 | 0.70 | 10.56 | 0.11 | 1.61 | 15.27 | 0.03 | 0.50 | 4.69 | 0.005 | 0.07 | 0.68 | 1:3.3 |
| 229 | Do | 94.81 | 0.54 | 10.36 | 0.08 | 1.47 | 14.19 | 0.01 | 0.12 | 1.19 | 0.002 | 0.03 | 0.32 | 1:11.9 |
| 12 | Ampalaya | 94.56 | 0.64 | 11.74 | 0.08 | 1.38 | 11.78 | 0.02 | 0.39 | 3.36 | 0.002 | 0.04 | 0.32 | 1:3.5 |
| 181 | Malungai | 90.31 | 1.40 | 14.45 | 0.19 | 1.93 | 13.33 | 0.01 | 0.14 | 0.94 | 0.005 | 0.05 | 0.38 | 1:14.1 |
| 202 | Butuan | 92.35 | 1.10 | 14.35 | 0.15 | 1.95 | 13.58 | 0.04 | 0.48 | 3.32 | 0.005 | 0.07 | 0.49 | 1:4.1 |
| 204 | Saba | 92.49 | 1.27 | 16.93 | 0.15 | 2.02 | 11.92 | 0.03 | 0.40 | 2.34 | 0.004 | 0.05 | 0.31 | 1:5.1 |
| 323 | Tunas | 84.30 | 0.95 | 6.03 | 0.24 | 1.50 | 24.80 | 0.06 | 0.36 | 6.00 | 0.004 | 0.03 | 0.43 | 1:4.1 |
| 327 | Sincamas | 88.21 | 0.84 | 7.10 | 0.12 | 1.01 | 14.27 | 0.11 | 0.95 | 13.37 | 0.004 | 0.03 | 0.48 | 1:1.1 |
| 85 | Granadilla | 91.91 | 0.46 | 5.70 | 0.04 | 0.53 | 9.26 | 0.04 | 0.45 | 7.92 | 0.003 | 0.04 | 0.76 | 1:1.2 |
| 26 | Habichuelas | 91.94 | 0.51 | 6.31 | 0.10 | 1.21 | 19.25 | 0.06 | 0.73 | 11.77 | 0.002 | 0.02 | 0.36 | 1:1.6 |
| 42 | String beans | 90.93 | 0.66 | 7.24 | 0.12 | 1.34 | 18.51 | 0.09 | 1.01 | 13.96 | 0.004 | 0.04 | 0.60 | 1:1.3 |
| 337 | Dwarf wax beans | 92.07 | 0.67 | 8.42 | 0.16 | 2.01 | 23.93 | 0.08 | 1.01 | 12.05 | 0.003 | 0.04 | 0.50 | 1:2.0 |
| 339 | Wonder beans | 86.94 | 1.38 | 10.53 | 0.25 | 1.91 | 18.16 | 0.12 | 0.92 | 8.74 | 0.009 | 0.08 | 0.72 | 1:2.0 |
| 78 | Wax beans | 92.94 | 0.92 | 13.08 | 0.10 | 1.40 | 10.74 | 0.09 | 1.28 | 9.71 | 0.008 | 0.11 | 0.86 | 1:1.1 |
| 146 | Bush wax beans | 92.89 | 0.50 | 7.10 | 0.12 | 1.65 | 23.24 | 0.06 | 0.90 | 12.72 | 0.006 | 0.08 | 1.14 | 1:1.8 |
| 147 | Sheeras beans | 89.66 | 0.80 | 7.70 | 0.18 | 1.69 | 21.90 | 0.13 | 1.29 | 16.75 | 0.005 | 0.05 | 0.68 | 1:1.3 |
| 22 | Chicaro | 80.74 | 1.16 | 6.02 | 0.31 | 1.62 | 26.87 | 0.12 | 0.61 | 10.12 | 0.006 | 0.03 | 0.51 | 1:2.7 |
| 34 | Do | 80.72 | 1.10 | 5.69 | 0.26 | 1.35 | 23.73 | 0.17 | 0.87 | 15.33 | 0.005 | 0.03 | 0.49 | 1:1.5 |
| 74 | Chinese peas | 87.60 | 0.84 | 6.81 | 0.20 | 1.59 | 23.42 | 0.15 | 1.23 | 18.06 | 0.005 | 0.04 | 0.59 | 1:1.3 |
| 336 | Cigarillas, seguidillas | 75.92 | 1.86 | 7.74 | 0.06 | 0.24 | 3.13 | 0.33 | 1.37 | 17.66 | 0.017 | 0.07 | 0.92 | 1:0.2 |
| 71 | Chayote | 95.06 | 0.30 | 6.00 | 0.04 | 0.80 | 13.38 | 0.35 | 0.70 | 11.69 | 0.001 | 0.02 | 0.33 | 1:1.1 |
| 343 | Katuray | 94.49 | 0.29 | 5.23 | 0.05 | 0.84 | 16.13 | 0.18 | 0.33 | 6.28 | 0.008 | 0.14 | 2.68 | 1:2.6 |
| 82 | Talong | 92.87 | 0.57 | 8.05 | 0.10 | 1.34 | 16.68 | 0.02 | 0.29 | 3.62 | 0.002 | 0.03 | 0.41 | 1:4.6 |
| 88 | Do | 94.19 | 0.55 | 9.42 | 0.07 | 1.22 | 12.94 | 0.03 | 0.48 | 5.14 | 0.002 | 0.04 | 0.37 | 1:2.5 |
| 257 | Do | 94.73 | 0.54 | 10.27 | 0.09 | 1.62 | 15.78 | 0.01 | 0.22 | 2.19 | 0.001 | 0.02 | 0.23 | 1:7.2 |
| 82 | Do | 92.80 | 0.71 | 9.82 | 0.09 | 1.21 | 12.37 | 0.05 | 0.63 | 6.41 | 0.003 | 0.04 | 0.45 | 1:1.9 |
| 279 | Sampalok | 68.97 | 1.40 | 4.52 | 0.16 | 0.53 | 11.77 | 0.32 | 1.03 | 22.81 | 0.004 | 0.01 | 0.32 | 1:0.5 |

TABLE 6.—*Phosphorus, calcium, and iron contents of the nonleafy vegetables and the corresponding calcium oxide-phosphorus pentoxide ratio of each*—Continued.

| Sample No. | Common name of plant. | Moisture. | Ash in— |  | Phosphorus ($P_2O_5$) in— |  |  | Calcium (CaO) in— |  |  | Iron ($Fe_2O_3$) in— |  |  | Ratio $CaO:P_2O_5$. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Fresh sample. | Moisture-free sample. | Fresh sample. | Moisture-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. |  |
|  |  | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |  |
| 113 | Sampaloc | 83.25 | 0.69 | 4.14 | 0.12 | 0.75 | 18.04 | 0.03 | 0.20 | 4.95 | 0.008 | 0.05 | 1.21 | 1:3.6 |
| 17 | Sitao puti | 86.24 | 1.08 | 7.85 | 0.20 | 1.47 | 18.76 | 0.12 | 0.84 | 10.74 | 0.006 | 0.04 | 0.53 | 1:1.7 |
| 45 | Sitao pula | 88.33 | 0.95 | 8.10 | 0.22 | 1.84 | 22.73 | 0.09 | 0.76 | 9.39 | 0.003 | 0.03 | 0.32 | 1:2.4 |
| 270 | Paayap | 89.47 | 0.87 | 8.28 | 0.20 | 1.91 | 23.02 | 0.12 | 1.17 | 14.13 | 0.003 | 0.03 | 0.33 | 1:1.6 |
| 271 | Bagbagcong | 90.33 | 1.49 | 15.40 | 0.28 | 2.93 | 19.02 | 0.14 | 1.47 | 9.57 | 0.004 | 0.04 | 0.29 | 1:1.9 |
| 246 | Shallot | 78.54 | 0.60 | 2.81 | 0.14 | 0.63 | 22.50 | 0.02 | 0.08 | 2.70 | 0.002 | 0.01 | 0.40 | 1:7.8 |
| 245 | Sibuyas, onion | 92.50 | 0.37 | 4.93 | 0.08 | 1.12 | 22.63 | 0.03 | 0.34 | 6.83 | 0.002 | 0.02 | 0.46 | 1:3.3 |
| 248 | Garlic, bauang, ajo | 64.39 | 1.19 | 3.35 | 0.31 | 0.86 | 25.80 | 0.01 | 0.02 | 0.43 | 0.002 | 0.01 | 0.14 | 1:43 |

TABLE 7.—*Distribution of nonleafy vegetables according to the ash, phosphorus, calcium, and iron contents.*[a]

| Ash. | Samples analyzed. | Phosphorus pentoxide. | Samples analyzed. | Calcium oxide. | Samples analyzed. | Ferric oxide. | Samples analyzed. |
|---|---|---|---|---|---|---|---|
| *Per cent.* |  | *Per cent.* |  | *Per cent.* |  | *Per cent.* |  |
| 1.25– 5.00 | 9 | 0.16–0.50 | 4 | 0.08–0.25 | 11 | 0.01–0.02 | 17 |
| 5.01–10.00 | 30 | 0.51–1.50 | 36 | 0.26–0.75 | 29 | 0.03–0.05 | 34 |
| 10.01–15.00 | 21 | 1.51–2.50 | 23 | 0.76–1.25 | 21 | 0.06–0.08 | 11 |
| 15.01–18.15 | 9 | 2.51–3.50 | 6 | 1.26–1.47 | 8 | 0.09–0.14 | 7 |

[a] Percentages are based on the moisture-free samples.

TABLE 8.—*Phosphorus, calcium, and iron contents of fruits, and the corresponding calcium oxide-phosphorus pentoxide ratio of each.*

| Sample No. | Common name of plant. | Moisture. | Ash in— | | Phosphorus ($P_2O_5$) in— | | | Calcium (CaO) in— | | | Iron ($Fe_2O_3$) in— | | | Ratio $CaO:P_2O_5$. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fresh sample. | Moisture-free sample. | Fresh sample. | Moisture-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. | |
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | |
| 208 | Chico | 75.45 | 0.39 | 1.57 | 0.03 | 0.11 | 7.25 | 0.03 | 0.12 | 7.79 | 0.004 | 0.02 | 1.05 | 1:0.9 |
| 206 | Piña | 89.96 | 0.42 | 4.15 | 0.02 | 0.17 | 4.02 | 0.02 | 0.24 | 4.68 | 0.004 | 0.04 | 0.90 | 1:0.9 |
| 240 | Do | 89.89 | 0.40 | 3.56 | 0.02 | 0.21 | 5.88 | 0.03 | 0.31 | 8.73 | 0.002 | 0.01 | 0.39 | 1:0.7 |
| 155 | Do | 89.43 | 0.39 | 3.68 | 0.02 | 0.22 | 6.09 | 0.01 | 0.14 | 3.77 | 0.004 | 0.03 | 0.91 | 1:1.6 |
| 128 | Mamon | 89.07 | 0.72 | 6.60 | 0.10 | 0.87 | 13.17 | 0.04 | 0.38 | 5.76 | 0.002 | 0.02 | 0.29 | 1:2.3 |
| 238 | Guayabano | 86.26 | 0.61 | 4.46 | 0.05 | 0.38 | 8.63 | 0.01 | 0.04 | 0.93 | 0.001 | 0.01 | 0.25 | 1:9.2 |
| 172 | Ates | 74.77 | 0.81 | 3.21 | 0.13 | 0.53 | 16.50 | 0.05 | 0.18 | 5.69 | 0.002 | 0.01 | 0.28 | 1:2.8 |
| 207 | Bignai | 91.11 | 0.57 | 6.41 | 0.04 | 0.50 | 7.84 | 0.12 | 1.34 | 20.94 | 0.001 | 0.01 | 0.21 | 1:0.4 |
| 244 | Nangka | 72.72 | 0.96 | 3.52 | 0.07 | 0.24 | 6.84 | 0.03 | 0.12 | 3.37 | 0.001 | 0.002 | 0.06 | 1:2.0 |
| 199 | Kamias | 94.82 | 0.36 | 6.98 | 0.04 | 0.82 | 11.75 | 0.009 | 0.17 | 2.37 | 0.002 | 0.04 | 0.54 | 1:5.0 |
| 168 | Balimbing | 93.35 | 0.46 | 6.97 | 0.05 | 0.70 | 10.09 | 0.004 | 0.07 | 0.96 | 0.002 | 0.04 | 0.58 | 1:10.5 |
| 273 | Chico mamey | 75.04 | 0.91 | 3.65 | 0.06 | 0.25 | 6.94 | 0.02 | 0.08 | 2.32 | 0.001 | 0.05 | 0.15 | 1:3.0 |
| 239 | Papaya | 93.23 | 0.74 | 10.99 | 0.03 | 0.40 | 3.67 | 0.03 | 0.46 | 4.15 | 0.002 | 0.03 | 0.28 | 1:0.9 |
| 241 | Do | 90.19 | 0.37 | 3.75 | 0.03 | 0.29 | 7.67 | 0.01 | 0.11 | 2.91 | 0.001 | 0.01 | 0.85 | 1:2.6 |
| 242 | Do | 92.11 | 0.54 | 6.84 | 0.04 | 0.45 | 6.51 | 0,03 | 0.37 | 5.46 | 0.009 | 0.01 | 0.18 | 1:1.2 |
| 94 | Sandia | 94.49 | 0.43 | 7.89 | 0.04 | 0.82 | 10.39 | 0.02 | 0.30 | 3.92 | 0.002 | 0.04 | 0.55 | 1:2.6 |
| 184 | Lemon | 94.81 | 0.44 | 8.56 | 0.06 | 1.17 | 13.63 | 0.04 | 0.74 | 8.60 | 0.003 | 0.06 | 0.64 | 1:1.5 |
| 102 | Lukban | 87.88 | 0.55 | 4.57 | 0.08 | 0.66 | 14.43 | 0.04 | 0.37 | 8.13 | 0.004 | 0.03 | 0.68 | 1:1.7 |
| 252 | Kalamondin, kalamansi | 87.08 | 0.64 | 4.99 | 0.07 | 0.56 | 11.41 | 0.14 | 1.06 | 21.31 | 0.003 | 0.02 | 0.43 | 1:0.5 |
| 123 | Melon castila | 95.54 | 0.64 | 14.42 | 0.03 | 0.68 | 4.69 | 0.04 | 0.91 | 6.34 | 0.002 | 0.04 | 0.29 | 1:0.7 |
| 124 | Melon tagalog | 94.83 | 1.03 | 19.89 | 0.06 | 1.24 | 6.24 | 0.06 | 1.18 | 5.92 | 0.01 | 0.21 | 0.56 | 1:1.1 |
| 863 | Cantaloupe | 95.86 | 0.50 | 12.19 | 0.05 | 1.24 | 10.20 | 0.03 | 0.73 | 6.02 | 0.001 | 0.03 | 0.23 | 1:1.7 |
| 864 | Do | 95.72 | 0.55 | 12.88 | 0.05 | 1.25 | 9.71 | 0.02 | 0.55 | 4.26 | 0.001 | 0.03 | 0.21 | 1:2.8 |
| 865 | Do | 95.39 | 0.53 | 11.48 | 0.03 | 0.66 | 5.76 | 0.03 | 0.63 | 5.53 | 0.001 | 0.02 | 0.17 | 1:1.0 |
| 866 | Do | 93.84 | 0.84 | 13.58 | 0.06 | 1.00 | 7.38 | 0.02 | 0.36 | 2.62 | 0.002 | 0.02 | 0.18 | 1:2.8 |

TABLE 8.—*Phosphorus, calcium, and iron contents of f ruits, and the corresponding calcium oxide-phosphorus pentoxide ratio of each*—Continued.

| Sample No. | Common name of plant. | Moisture. | Ash in— | | Phosphorus ($P_2O_5$) in— | | | Calcium (CaO) in— | | | Iron ($Fe_2O_3$) in— | | | Ratio $CaO:P_2O_5$. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fresh sample. | Moisture-free sample. | Fresh sample. | Moisture-free sample. | Ash. | Fresh sample. | Moisture-free sample. | Ash. | Fresh sample | Moisture-free sample. | Ash. | |
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cedt.* | |
| 367 | Cantaloupe | 93.80 | 0.62 | 10.06 | 0.04 | 0.69 | 6.85 | 0.02 | 0.28 | 2.81 | 0.002 | 0.03 | 0.31 | 1:2.4 |
| 368 | Do | 91.25 | 0.81 | 9.24 | 0.06 | 0.73 | 7.85 | 0.01 | 0.17 | 1.85 | 0.003 | 0.03 | 0.33 | 1:4.2 |
| 287 | Cajel | 91.69 | 0.43 | 5.23 | 0.06 | 0.70 | 13.45 | 0.01 | 0.17 | 3.30 | 0.002 | 0.03 | 0.52 | 1:4.1 |
| 298 | Naranjita | 91.89 | 0.29 | 3.62 | 0.04 | 0.46 | 12.81 | 0.02 | 0.20 | 5.45 | 0.0006 | 0.01 | 0.22 | 1:2.4 |
| 286 | Cyndra | 86.73 | 0.65 | 4.87 | 0.13 | 0.99 | 20.39 | 0.01 | 0.08 | 1.71 | 0.002 | 0.01 | 0.27 | 1:11.9 |
| 188 | Tambis | 94.42 | 0.29 | 5.19 | 0.03 | 0.47 | 9.04 | 0.01 | 0.20 | 3.80 | 0.004 | 0.06 | 1.26 | 1:2.8 |
| 234 | Catmon | 90.17 | 0.69 | 6.97 | 0.06 | 0.58 | 8.36 | 0.06 | 0.58 | 8.30 | 0.003 | 0.03 | 0.41 | 1:1.0 |
| 122 | Mabolo | 84.26 | 0.64 | 4.04 | 0.08 | 0.48 | 11.84 | 0.07 | 0.48 | 11.89 | 0.005 | 0.03 | 0.78 | 1:1.0 |
| 169 | Do | 84.43 | 0.72 | 4.64 | 0.06 | 0.38 | 8.27 | 0.04 | 0.25 | 5.44 | 0.001 | 0.01 | 0.11 | 1:1.5 |
| 388 | Do | 73.62 | 0.58 | 2.18 | 0.05 | 0.18 | 8.26 | 0.05 | 0.20 | 8.96 | 0.001 | 0.005 | 0.25 | 1:0.9 |
| 317 | Sapote | 80.06 | 0.42 | 2.12 | 0.04 | 0.21 | 10.11 | 0.02 | 0.08 | 3.63 | 0.001 | 0.005 | 0.24 | 1:2.8 |
| 115 | Duhat | 85.44 | 0.70 | 4.78 | 0.07 | 0.48 | 10.12 | 0.04 | 0.27 | 5.61 | 0.005 | 0.03 | 0.71 | 1:1.8 |
| 167 | Makopa | 92.96 | 0.21 | 2.94 | 0.03 | 0.41 | 13.95 | 0.01 | 0.14 | 4.87 | 0.001 | 0.01 | 0.40 | 1:2.8 |
| 374 | Ternana | 92.39 | 0.34 | 4.47 | 0.03 | 0.37 | 8.37 | 0.03 | 0.34 | 7.71 | 0.004 | 0.05 | 1.06 | 1:1.1 |
| 283 | Maigang | 88.73 | 0.53 | 4.70 | 0.03 | 0.28 | 5.93 | 0.07 | 0.58 | 12.29 | 0.006 | 0.05 | 1.04 | 1:0.5 |
| 190 | Agbay | 82.59 | 1.19 | 8.26 | 0.09 | 0.66 | 7.95 | 0.01 | 1.16 | 14.10 | 0.002 | 0.01 | 0.18 | 1:0.6 |
| 187 | Tibig | 92.08 | 1.27 | 16.05 | 0.08 | 0.47 | 6.26 | 0.04 | 3.46 | 21.54 | 0.006 | 0.08 | 0.48 | 1:0.3 |
| 282 | Serali | 80.81 | 0.87 | 4.54 | 0.06 | 0.30 | 6.50 | 0.09 | 0.48 | 10.50 | 0.001 | 0.01 | 0.15 | 1:0.6 |
| 91 | Strawberry | 90.86 | 0.81 | 8.82 | 0.08 | 0.84 | 9.52 | 0.05 | 0.57 | 6.50 | 0.001 | 0.01 | 0.14 | 1:1.5 |
| 373 | Garcinia | 86.13 | 0.42 | 3.04 | 0.03 | 0.25 | 8.14 | 0.02 | 0.14 | 4.69 | 0.001 | 0.01 | 0.23 | 1:1.7 |
| 389 | Taklang-anak | 88.28 | 0.45 | 3.88 | 0.04 | 0.37 | 9.66 | 0.01 | 0.10 | 2.66 | 0.009 | 0.01 | 0.21 | 1:3.6 |
| 381 | Mangosteen | 81.89 | 0.19 | 1.04 | 0.05 | 0.25 | 24.45 | 0.01 | 0.05 | 5.19 | 0.002 | 0.01 | 0.81 | 1:4.7 |
| 390 | Gatasan | 88.78 | 0.35 | 3.08 | 0.03 | 0.29 | 9.31 | 0.02 | 0.14 | 4.39 | 0.001 | 0.01 | 0.42 | 1:2.1 |
| 284 | Piris | 90.47 | 0.29 | 3.07 | 0.02 | 0.20 | 6.42 | 0.01 | 0.16 | 5.16 | 0.005 | 0.05 | 1.56 | 1:1.2 |
| 189 | Kamuling | 77.50 | 1.04 | 4.63 | 0.09 | 0.39 | 8.61 | 0.09 | 0.40 | 8.74 | 0.005 | 0.02 | 0.49 | 1:1.0 |
| 324 | Lanzones | 84.47 | 0.50 | 3.24 | 0.07 | 0.42 | 13.03 | 0.01 | 0.07 | 2.10 | 0.007 | 0.004 | 0.13 | 1:6.2 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 125 | Litchi | 87.41 | 0.53 | 4.18 | 0.10 | 0.79 | 18.89 | 0.02 | 0.18 | 4.31 | 0.002 | 0.02 | 0.42 | 1:4.8 |
| 218 | Manga | 86.74 | 0.38 | 2.90 | 0.05 | 0.48 | 16.39 | 0.01 | 0.05 | 1.89 | 0.001 | 0.01 | 0.42 | 1:8.6 |
| 219 | Do | 87.16 | 0.29 | 2.29 | 0.04 | 0.38 | 16.58 | 0.01 | 0.05 | 2.14 | 0.001 | 0.01 | 0.59 | 1:7.7 |
| 209 | Do | 85.34 | 0.33 | 2.25 | 0.04 | 0.27 | 12.18 | 0.008 | 0.05 | 2.41 | 0.003 | 0.02 | 0.98 | 1:5.1 |
| 222 | Latundan | 78.63 | 0.65 | 3.04 | 0.07 | 0.35 | 11.63 | 0.02 | 0.02 | 0.70 | 0.002 | 0.01 | 0.34 | 1:16.0 |
| 223 | Saba | 74.69 | 0.61 | 2.41 | 0.07 | 0.28 | 11.71 | 0.01 | 0.03 | 1.20 | 0.002 | 0.01 | 0.36 | 1:9.7 |
| 221 | Lacatan | 76.10 | 0.63 | 2.62 | 0.06 | 0.26 | 10.05 | 0.02 | 0.02 | 0.90 | 0.001 | 0.04 | 0.17 | 1:11.1 |
| 220 | Bungulan | 74.68 | 0.78 | 3.07 | 0.04 | 0.17 | 5.47 | 0.01 | 0.02 | 0.58 | 0.001 | 0.01 | 0.18 | 1:9.4 |
| 231 | Gloria | 63.93 | 1.10 | 3.06 | 0.07 | 0.20 | 6.68 | 0.001 | 0.003 | 0.11 | 0.002 | 0.004 | 0.14 | 1:60.7 |
| 285 | Morado | 76.43 | 0.81 | 3.43 | 0.06 | 0.25 | 7.20 | 0.009 | 0.04 | 1.12 | 0.001 | 0.004 | 0.12 | 1:6.4 |
| 138 | Mulberry | 87.69 | 0.98 | 7.95 | 0.14 | 1.11 | 13.93 | 0.17 | 1.41 | 17.79 | 0.004 | 0.04 | 0.45 | 1:0.8 |
| 114 | Bulala | 90.87 | 0.43 | 4.66 | 0.05 | 0.56 | 11.95 | 0.01 | 0.05 | 1.07 | 0.002 | 0.03 | 0.54 | 1:11.1 |
| 64 | Passiflora alba | 73.60 | 1.18 | 4.47 | 0.25 | 0.94 | 21.09 | 0.02 | 0.09 | 2.04 | 0.007 | 0.03 | 0.56 | 1:10.3 |
| 161 | Lilikoi | 73.86 | 0.86 | 3.24 | 0.17 | 0.63 | 19.37 | 0.03 | 0.10 | 2.99 | 0.006 | 0.02 | 0.74 | 1:6.4 |
| 65 | Passiflora mollisima | 87.69 | 0.73 | 5.90 | 0.09 | 0.74 | 12.59 | 0.02 | 0.17 | 2.84 | 0.001 | 0.01 | 0.20 | 1:4.4 |
| 210 | Guava | 81.82 | 0.66 | 3.61 | 0.10 | 0.57 | 15.90 | 0.02 | 0.11 | 3.02 | 0.003 | 0.02 | 0.49 | 1:5.3 |
| 265 | Avocado | 82.61 | 0.85 | 4.88 | 0.12 | 0.67 | 13.70 | 0.01 | 0.05 | 0.94 | 0.003 | 0.02 | 0.37 | 1:14.5 |
| 227 | Granada | 77.81 | 0.85 | 3.82 | 0.15 | 0.69 | 17.95 | 0.01 | 0.03 | 0.86 | 0.006 | 0.03 | 0.80 | 1:20.8 |
| 243 | Pears | 90.65 | 0.23 | 2.46 | 0.02 | 0.24 | 9.70 | 0.006 | 0.07 | 2.66 | 0.002 | 0.02 | 0.72 | 1:3.6 |
| 305 | Apples | 85.03 | 0.37 | 2.47 | 0.04 | 0.25 | 10.09 | 0.005 | 0.03 | 1.41 | 0.001 | 0.01 | 0.35 | 1:7.2 |
| 306 | Do | 85.72 | 0.33 | 2.30 | 0.04 | 0.26 | 11.19 | 0.004 | 0.03 | 1.36 | 0.001 | 0.01 | 0.40 | 1:8.2 |
| 170 | Santol | 85.50 | 0.65 | 4.45 | 0.03 | 0.20 | 4.47 | 0.01 | 0.06 | 1.45 | 0.002 | 0.01 | 0.26 | 1:3.1 |
| 313 | Mombin | 85.82 | 0.80 | 5.65 | 0.13 | 0.91 | 16.06 | 0.01 | 0.07 | 1.32 | 0.007 | 0.05 | 0.90 | 1:12.2 |
| 391 | Hevi | 84.65 | 0.49 | 3.19 | 0.06 | 0.38 | 11.84 | 0.03 | 0.22 | 6.96 | 0.003 | 0.02 | 0.52 | 1:1.7 |
| 116 | Ciruelas | 85.44 | 0.57 | 3.92 | 0.11 | 0.78 | 19.78 | 0.01 | 0.08 | 2.15 | 0.003 | 0.02 | 0.61 | 1:9.2 |
| 194 | Putoputohan | 76.32 | 1.61 | 6.78 | 0.25 | 1.03 | 15.22 | 0.15 | 0.62 | 9.19 | 0.002 | 0.01 | 0.15 | 1:1.7 |
| 281 | Sampaloc | 35.88 | 3.93 | 6.08 | 0.34 | 0.53 | 8.70 | 0.13 | 0.20 | 3.22 | 0.002 | 0.02 | 0.40 | 1:2.7 |
| 121 | Peach | 88.74 | 0.55 | 4.88 | 0.05 | 0.45 | 9.25 | 0.01 | 0.07 | 1.38 | 0.002 | 0.02 | 0.43 | 1:6.7 |
| 196 | Plums | 89.69 | 0.38 | 3.71 | 0.07 | 0.64 | 17.32 | 0.01 | 0.08 | 2.21 | 0.002 | 0.02 | 0.41 | 1:7.8 |
| 238 | Do | 88.54 | 0.32 | 2.76 | 0.03 | 0.26 | 9.26 | 0.01 | 0.07 | 2.62 | 0.002 | 0.02 | 0.63 | 1:3.5 |
| 197 | Sweet cherries | 83.74 | 0.62 | 3.82 | 0.08 | 0.51 | 13.34 | 0.02 | 0.13 | 3.43 | 0.003 | 0.02 | 0.56 | 1:3.8 |
| 195 | Apricot | 88.72 | 0.83 | 7.38 | 0.12 | 1.10 | 14.90 | 0.04 | 0.34 | 4.56 | 0.003 | 0.02 | 0.33 | 1:3.2 |
| 275 | Susong calabao | 78.32 | 1.22 | 5.65 | 0.10 | 0.48 | 8.41 | 0.03 | 0.15 | 2.63 | 0.010 | 0.06 | 1.07 | 1:3.2 |
| 100 | Baguio blueberry | 79.75 | 0.41 | 2.04 | 0.05 | 0.23 | 11.45 | 0.06 | 0.30 | 14.72 | 0.007 | 0.04 | 1.81 | 1:0.8 |
| 348 | Manzanitas | 79.10 | 0.80 | 3.81 | 0.07 | 0.32 | 8.53 | 0.04 | 0.18 | 4.68 | 0.003 | 0.01 | 0.33 | 1:1.8 |
| 318 | Do | 85.52 | 0.39 | 2.70 | 0.02 | 0.17 | 6.24 | 0.03 | 0.20 | 7.31 | 0.003 | 0.02 | 0.79 | 1:0.9 |

TABLE 9.—*Distribution of edible fruits according to the ash, phosphorus, calcium, and iron contents.*[a]

| Ash. | Samples analyzed. | Phosphorus pentoxide. | Samples analyzed. | Calcium oxide. | Samples analyzed. | Ferric oxide. | Samples analyzed. |
|---|---|---|---|---|---|---|---|
| *Per cent.* | | *Per cent.* | | *Per cent.* | | *Per cent.* | |
| 1.57– 4.99 | 58 | 0.11–0.30 | 28 | 0.02–0.09 | 29 | 0.002–0.004 | 4 |
| 5.19– 9.24 | 20 | 0.31–0.60 | 29 | 0.10–0.50 | 43 | 0.01 –0.03 | 65 |
| 10.06–15.00 | 7 | 0.61–0.99 | 22 | 0.51–1.00 | 9 | 0.04 –0.07 | 14 |
| 15.01–19.89 | 2 | 1.00–1.25 | 8 | 1.01–3.46 | 6 | 0.08 –0.21 | 2 |

[a] Percentages are based on the moisture-free samples.

TABLE 10.—*Phosphorus, calcium, and iron contents of seeds and the corresponding calcium oxide-phosphorus pentoxide ratio of each.*

| Sample No. | Common name of plant. | Moisture. | Ash in— | | Phosphorus ($P_2O_5$) in— | | | Calcium (CaO) in— | | | Iron ($Fe_2O_3$) in— | | | Ratio CaO:$P_2O_5$. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample analyzed. | Moisture-free sample. | Fresh sample. | Moisture-free sample. | Ash. | Sample analyzed. | Moisture-free sample. | Ash. | Sample analyzed. | Moisture-free sample. | Ash. | |
| | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | |
| 356 | Kasoy | 9.02 | 2.49 | 2.74 | 1.12 | 1.23 | 44.89 | 0.04 | 0.04 | 1.46 | 0.009 | 0.010 | 0.37 | 1:30.7 |
| 276 | Mani | 10.98 | 2.33 | 2.62 | 1.02 | 1.15 | 43.89 | 0.29 | 0.33 | 12.59 | 0.002 | 0.003 | 0.11 | 1:3.5 |
| 277 | Do | 36.53 | 1.91 | 3.01 | 0.72 | 1.13 | 37.54 | 0.13 | 0.20 | 6.64 | 0.002 | 0.004 | 0.13 | 1:5.7 |
| 247 | Nangka | 57.77 | 1.25 | 2.96 | 0.23 | 0.54 | 18.24 | 0.06 | 0.13 | 4.39 | 0.002 | 0.005 | 0.17 | 1:4.2 |
| 224 | Putat | 95.42 | 0.15 | 3.38 | 0.03 | 0.77 | 22.79 | 0.001 | 0.02 | 0.69 | 0.001 | 0.009 | 0.26 | 1:33 |
| 362 | Kadios | 15.13 | 3.01 | 3.55 | 0.77 | 0.91 | 25.63 | 0.33 | 0.39 | 10.98 | 0.012 | 0.018 | 0.37 | 1:2.3 |
| 297 | Pili | 47.62 | 1.73 | 3.30 | 0.87 | 1.66 | 50.30 | 0.14 | 0.27 | 8.18 | 0.003 | 0.006 | 0.18 | 1:6.1 |
| 514 | Ilas | 10.47 | 2.08 | 2.32 | 0.88 | 0.98 | 42.09 | 0.04 | 0.05 | 2.06 | 0.012 | 0.013 | 0.58 | 1:21 |
| 249 | Niog | 77.03 | 1.06 | 4.61 | 0.19 | 0.82 | 17.68 | 0.01 | 0.06 | 1.23 | 0.003 | 0.014 | 0.30 | 1:14.4 |
| 250 | Do | 68.85 | 0.58 | 1.70 | 0.16 | 0.50 | 29.51 | 0.004 | 0.01 | 0.69 | 0.002 | 0.005 | 0.32 | 1:42.8 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 251 | Do | 74.41 | 0.58 | 2.26 | 0.15 | 0.57 | 25.43 | 0.01 | 0.03 | 1.53 | 0.001 | 0.005 | 0.23 | 1:16.6 |
| 358 | Soy bean | 6.58 | 4.68 | 5.01 | 1.06 | 1.14 | 22.75 | 0.24 | 0.26 | 5.19 | 0.018 | 0.019 | 0.38 | 1:3.4 |
| 261 | Soy bean sprouts | 80.65 | 1.01 | 5.21 | 0.29 | 1.52 | 29.11 | 0.06 | 0.30 | 5.76 | 0.003 | 0.014 | 0.26 | 1:5.1 |
| 322 | Lauas | 64.09 | 0.42 | 1.17 | 0.12 | 0.33 | 28.24 | 0.01 | 0.03 | 2.79 | 0.001 | 0.004 | 0.32 | 1:10.1 |
| 80 | Chicharo | 81.30 | 0.82 | 4.40 | 0.32 | 1.69 | 38.45 | 0.02 | 0.08 | 1.83 | 0.004 | 0.024 | 0.54 | 1:21 |
| 351 | Mungo | 13.05 | 2.98 | 3.43 | 0.78 | 0.90 | 26.23 | 0.14 | 0.16 | 4.66 | 0.014 | 0.016 | 0.47 | 1:5.6 |
| 173 | Togue | 88.53 | 0.53 | 4.63 | 0.17 | 1.47 | 31.75 | 0.01 | 0.04 | 0.96 | 0.003 | 0.029 | 0.63 | 1:33 |
| 174 | Do | 70.94 | 1.95 | 6.71 | 0.57 | 1.97 | 29.40 | 0.03 | 0.12 | 1.79 | 0.007 | 0.025 | 0.38 | 1:16.4 |
| 174-A | Do | 80.15 | 1.01 | 5.07 | 0.22 | 1.09 | 21.56 | 0.02 | 0.12 | 2.40 | 0.004 | 0.020 | 0.40 | 1.9 |
| 148 | Sheeras beans | 59.73 | 1.90 | 4.71 | 0.67 | 1.66 | 35.29 | 0.16 | 0.40 | 8.42 | 0.014 | 0.034 | 0.72 | 1:4.2 |
| 350 | Mungo | 12.32 | 2.77 | 3.16 | 0.81 | 0.92 | 29.11 | 0.14 | 0.16 | 5.06 | 0.012 | 0.014 | 0.44 | 1:5.8 |
| 360 | Patani | 59.66 | 1.82 | 4.52 | 0.34 | 0.85 | 18.80 | 0.03 | 0.08 | 1.76 | 0.004 | 0.010 | 0.22 | 1:10.7 |
| 360-A | Do | 57.43 | 2.01 | 4.71 | 0.44 | 1.02 | 21.65 | 0.01 | 0.02 | 0.42 | 0.005 | 0.011 | 0.23 | 1:51.5 |
| 361 | Mungo | 9.15 | 3.79 | 4.17 | 0.93 | 1.02 | 24.46 | 0.42 | 0.47 | 11.27 | 0.009 | 0.010 | 0.24 | 1:2 |
| 363 | Bigas | 11.03 | 0.87 | 0.98 | 0.60 | 0.68 | 69.38 | 0.018 | 0.02 | 2.04 | 0.002 | 0.002 | 0.20 | 1:34.7 |
| 363-A | Tikitiki | 15.87 | 9.06 | 10.77 | 4.68 | 5.66 | 52.61 | 0.009 | 0.017 | 0.10 | 0.022 | 0.026 | 0.24 | 1:52.6 |
| 353 | Sesame | 5.98 | 6.23 | 6.63 | 1.73 | 1.84 | 27.75 | 0.66 | 0.70 | 10.57 | 0.007 | 0.008 | 0.12 | 1:2.6 |
| 235 | Maiz | 90.17 | 0.13 | 1.35 | 0.08 | 0.85 | 62.96 | 0.002 | 0.17 | 12.59 | 0.001 | 0.005 | 0.37 | 1:5 |
| 357 | Do | 11.64 | 1.29 | 1.46 | 0.57 | 0.65 | 44.52 | 0.07 | 0.08 | 5.48 | 0.006 | 0.007 | 0.48 | 1:13.4 |
| 236 | Do | 67.04 | 0.39 | 1.18 | 0.11 | 0.35 | 29.43 | 0.005 | 0.014 | 1.19 | 0.001 | 0.002 | 0.21 | 1:24.7 |
| 278 | Sitao | 59.73 | 1.90 | 4.71 | 0.67 | 1.66 | 35.29 | 0.16 | 0.40 | 8.42 | 0.014 | 0.034 | 0.72 | 1:4.2 |
| 359 | Nuez | 5.56 | 1.80 | 1.91 | 0.78 | 0.83 | 43.45 | 0.149 | 0.15 | 7.85 | 0.004 | 0.004 | 0.21 | 1:5.5 |

TABLE 11.—*Distribution of edible seeds according to the ash, phosphorus, calcium, and iron contents.*[a]

| Ash. | Samples analyzed. | Phosphorus pentoxide. | Samples analyzed. | Calcium oxide. | Samples analyzed. | Ferric oxide. | Samples analyzed. |
|---|---|---|---|---|---|---|---|
| *Per cent.* | | *Per cent.* | | *Per cent.* | | *Per cent.* | |
| 0.98-2.50 | 8 | 0.35-0.75 | 7 | 0.01-0.09 | 13 | 0.002-0.005 | 11 |
| 2.51-4.50 | 12 | 0.76-1.25 | 15 | 0.10-0.39 | 10 | 0.006-0.009 | 4 |
| 4.51-6.63 | 8 | 1.26-5.66 | 6 | 0.40-0.70 | 5 | 0.01 -0.030 | 13 |

[a] Percentages are based on the moisture-free samples.

TABLE 12.—*Phosphorus, calcium, and iron contents of roots, rhizomes, and tubers and the corresponding calcium oxide-phosphorus pentoxide ratio of each.*

| Sample No. | Common name of plant. | Moisture. | Ash in— |  | Phosphorus ($P_2O_5$) in— |  |  | Calcium (CaO) in— |  |  | Iron ($Fe_2O_3$) in— |  |  | Ratio $CaO:P_2O_5$. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Sample analyzed. | Moisture-free sample. | Sample analyzed. | Moisture-free sample. | Ash. | Sample analyzed. | Moisture-free sample. | Ash. | Sample analyzed. | Moisture-free sample. | Ash. |  |
|  |  | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |  |
| 53 | Remolacha | 90.26 | 1.32 | 13.58 | 0.11 | 1.42 | 8.41 | 0.02 | 0.16 | 1.18 | 0.003 | 0.03 | 0.23 | 1:7 |
| 262 | Beet | 89.20 | 0.82 | 7.61 | 0.12 | 1.07 | 14.02 | 0.01 | 0.15 | 1.77 | 0.004 | 0.04 | 0.49 | 1:7.9 |
| 263 | Do | 86.92 | 1.93 | 14.73 | 0.18 | 1.41 | 9.58 | 0.02 | 0.17 | 1.17 | 0.004 | 0.03 | 0.21 | 1:8.2 |
| 101 | Rutabaga | 91.63 | 1.05 | 12.58 | 0.15 | 1.78 | 14.12 | 0.09 | 1.12 | 8.93 | 0.007 | 0.08 | 0.66 | 1:1.6 |
| 232 | Do | 90.38 | 0.52 | 5.45 | 0.08 | 0.88 | 16.17 | 0.04 | 0.40 | 7.28 | 0.003 | 0.03 | 0.56 | 1:2.2 |
| 264 | Turnip | 94.79 | 0.58 | 11.04 | 0.07 | 1.29 | 11.72 | 0.04 | 0.85 | 7.69 | 0.002 | 0.03 | 0.29 | 1:1.5 |
| 316 | Do | 93.40 | 0.62 | 9.37 | 0.08 | 1.25 | 13.34 | 0.06 | 0.92 | 9.78 | 0.001 | 0.02 | 0.17 | 1:1.4 |
| 86 | Gabi | 65.29 | 1.26 | 3.63 | 0.18 | 0.52 | 14.26 | 0.11 | 0.30 | 8.36 | 0.003 | 0.01 | 0.24 | 1:1.7 |
| 307 | Do | 63.76 | 0.72 | 1.99 | 0.14 | 0.38 | 19.27 | 0.03 | 0.09 | 4.36 | 0.001 | 0.003 | 0.16 | 1:4.4 |
| 213 | Dilau | 86.90 | 1.21 | 9.26 | 0.17 | 1.33 | 14.32 | 0.02 | 0.13 | 1.39 | 0.008 | 0.06 | 0.66 | 1:10.8 |
| 81 | Carrot | 89.07 | 1.25 | 11.41 | 0.08 | 0.74 | 6.50 | 0.07 | 0.66 | 5.81 | 0.008 | 0.07 | 0.62 | 1:1.1 |
| 254 | Do | 88.06 | 1.45 | 12.18 | 0.22 | 1.82 | 14.96 | 0.07 | 0.55 | 4.51 | 0.003 | 0.03 | 0.21 | 1:3.3 |
| 258 | Do | 92.04 | 0.75 | 9.39 | 0.06 | 0.78 | 8.33 | 0.05 | 0.60 | 6.44 | 0.003 | 0.04 | 0.38 | 1:1.3 |
| 345 | Do | 91.30 | 0.62 | 7.12 | 0.07 | 0.77 | 10.87 | 0.03 | 0.34 | 4.83 | 0.001 | 0.02 | 0.24 | 1:2.3 |
| 347 | Ubi | 69.84 | 0.73 | 2.43 | 0.12 | 0.38 | 15.83 | 0.002 | 0.01 | 0.31 | 0.003 | 0.01 | 0.45 | 1:51 |
| 193 | Nami | 90.93 | 0.71 | 7.87 | 0.09 | 1.02 | 12.93 | 0.07 | 0.75 | 9.58 | 0.003 | 0.04 | 0.48 | 1:1.3 |
| 127 | Apulid | 41.82 | 1.10 | 1.89 | 0.34 | 0.58 | 30.60 | 0.02 | 0.03 | 1.43 | 0.003 | 0.01 | 0.26 | 1:21.8 |
| 126 | Chinese water chestnut | 79.99 | 1.17 | 5.83 | 0.21 | 1.05 | 17.96 | 0.005 | 0.03 | 0.46 | 0.006 | 0.03 | 0.52 | 1:0.4 |
| 154 | Camote | 68.37 | 0.67 | 2.12 | 0.12 | 0.38 | 18.14 | 0.03 | 0.08 | 4.09 | 0.003 | 0.01 | 0.41 | 1:4.4 |
| 179 | Do | 72.71 | 0.60 | 2.19 | 0.08 | 0.30 | 13.77 | 0.02 | 0.09 | 3.90 | 0.001 | 0.01 | 0.21 | 1:3.5 |
| 177 | Do | 64.86 | 1.07 | 3.04 | 0.12 | 0.35 | 11.45 | 0.05 | 0.13 | 4.38 | 0.008 | 0.02 | 0.77 | 1:2.6 |
| 176 | Do | 67.78 | 1.15 | 3.57 | 0.16 | 0.49 | 13.78 | 0.03 | 0.10 | 2.70 | 0.002 | 0.01 | 0.21 | 1:5.1 |
| 178 | Do | 62.46 | 0.98 | 2.62 | 0.13 | 0.35 | 13.30 | 0.05 | 0.14 | 5.19 | 0.002 | 0.01 | 0.19 | 1:2.6 |
| 183 | Do | 73.72 | 0.97 | 3.70 | 0.13 | 0.50 | 13.46 | 0.03 | 0.10 | 2.81 | 0.002 | 0.01 | 0.25 | 1:4.8 |
| 308 | Do | 63.20 | 1.26 | 3.42 | 0.14 | 0.38 | 11.11 | 0.02 | 0.06 | 1.80 | 0.002 | 0.01 | 0.19 | 1:6.2 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 87 | Sincamas | 90.32 | 0.40 | 4.15 | 0.04 | 0.45 | 10.85 | 0.04 | .39 | 9.33 | 0.003 | 0.03 | 0.65 | 1:1.2 |
| 54 | Parsnip | 72.20 | 1.97 | 6.61 | 0.22 | 0.85 | 12.92 | 0.10 | 0.35 | 5.22 | 0.005 | 0.02 | 0.24 | 1:2.5 |
| 259 | Do | 82.21 | 1.19 | 6.69 | 0.22 | 1.22 | 18.18 | 0.07 | 0.38 | 5.63 | 0.006 | 0.03 | 0.47 | 1:3.2 |
| 63 | Radish | 94.14 | 1.08 | 18.49 | 0.10 | 1.73 | 9.35 | 0.07 | 1.22 | 6.61 | 0.006 | 0.11 | 0.60 | 1:1.4 |
| 61 | Rabanos | 91.05 | 1.32 | 14.77 | 0.12 | 1.37 | 9.27 | 0.07 | 0.78 | 5.31 | 0.007 | 0.08 | 0.53 | 1:1.7 |
| 346 | Do | 94.94 | 0.62 | 12.22 | 0.64 | 1.26 | 10.30 | 0.02 | 0.46 | 3.78 | 0.003 | 0.05 | 0.42 | 1:2.7 |
| 69 | Patatas | 79.81 | 0.91 | 4.51 | 0.12 | 0.60 | 13.20 | 0.02 | 0.08 | 1.68 | 0.006 | 0.03 | 0.64 | 1:7.8 |
| 157 | Do | 84.38 | 0.68 | 4.34 | 0.12 | 0.79 | 18.26 | 0.01 | 0.08 | 1.80 | 0.003 | 0.02 | 0.42 | 1:10.1 |
| 214 | Luya | 80.60 | 1.39 | 7.14 | 0.15 | 0.78 | 10.90 | 0.02 | 0.09 | 1.29 | 0.006 | 0.03 | 0.41 | 1:8.4 |
| 310 | Do | 92.55 | 0.68 | 9.13 | 0.04 | 0.57 | 6.29 | 0.03 | 0.39 | 4.28 | 0.004 | 0.05 | 0.58 | 1:1.5 |

TABLE 13.—*Distribution of roots, rhizomes, and tubers according to the ash, phosphorus, calcium, and iron contents.*[a]

| Ash. | Samples analyzed. | Phosphorus pentoxide. | Samples analyzed. | Calcium oxide. | Samples. analyzed. | Ferric oxide. | Samples analyzed. |
|---|---|---|---|---|---|---|---|
| *Per cent.* | | *Per cent.* | | *Per cent.* | | *Per cent.* | |
| 1.99- 3.00 | 6 | 0.35-0.75 | 15 | 0.01-0.09 | 10 | 0.003-0.01 | 10 |
| 3.01- 6.00 | 9 | 0.76-1.25 | 11 | 0.10-0.50 | 16 | 0.02-0.04 | 18 |
| 6.01-12.00 | 13 | 1.26-1.50 | 6 | 0.51-1.00 | 7 | 0.05-0.07 | 4 |
| 12.01-18.49 | 7 | 1.51-1.73 | 3 | 1.01-1.22 | 2 | 0.08-0.11 | 8 |

[a] Percentages are based on the moisture-free samples.

**TABLE 14.**—*Some common Philippine food plants that serve as excellent sources for phosphorus, calcium, or iron.*

[Percentages are based on moisture-free samples.]

| Sample No. | Name of plant. | Part used. | Phosphorus ($P_2O_5$). | Calcium (CaO). | Iron ($Fe_2O_3$). |
|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | *Per cent.* |
| 28 | Ampalaya (*Momordica charantia*) | Leaves | -------- | 4.36 | 0.47 |
| 202 | Saba (*Musa sapientum* var. *compressa.*) | Heart | 2.02 | -------- | -------- |
| 337 | Chinese dwarf wax beans (*Phaseolus vulgaris.*) | Green pods | 2.01 | -------- | -------- |
| 48 | Beet (*Beta vulgaris*) | Leaves | -------- | 3.17 | 0.27 |
| 49 | Sprouting broccoli (*Brassica oleracea* var. *italica.*) | Leaves and flowering tops. | 2.45 | -------- | -------- |
| 47 | Cauliflower (*Brassica oleracea* var. *botrytis.*) | do | 2.02 | -------- | -------- |
| 132 | Chayote (*Sechium edule*) | Leaves and tops. | 3.01 | -------- | -------- |
| 270 | Cowpea (*Vigna sinensis*) | Green pods | 1.91 | -------- | -------- |
| 14 | Coriander, ongsoy (*Coriandrum sativum.*) | Leaves | -------- | 2.56 | 0.12 |
| 62 | Cucumber (*Cucumis sativus*) | Green fruits | 2.73 | -------- | -------- |
| 225 | Gabi (*Colocasia esculentum*) | Leaves | -------- | 2.22 | 0.10 |
| 205 | Kauayan toto-o (*Bambusa spinosa*) | Tender portion of shoot. | 2.12 | -------- | -------- |
| 9 | Kinchai (*Apium graveolens*) | Leaves | -------- | 2.45 | -------- |
| 2-A | Kangkong (*Ipomoea reptans*) | Leaves and tops. | 1.84 | -------- | 0.13 |
| 4 | Koles (*Brassica oleracea* var. *acephala*) | Leaves | -------- | 5.04 | |
| 159 | Kudiapa (*Amaranthus paniculatus*) | do | -------- | 3.57 | -------- |
| 1 | Kolitis (*Amaranthus viridis*) | do | 1.99 | 3.63 | 0.42 |
| 166 | Lettuce (*Lactuca sativa*) | do | -------- | 2.78 | 0.28 |
| 11 | Libato, alugbati (*Basella rubra*) | do | -------- | 3.33 | 0.18 |
| 40 | Malungai (*Moringa oleifera*) | do | -------- | 3.47 | 0.52 |
| 6 | Mustard (*Brassica integrifolia*) | do | 2.20 | 2.47 | 0.18 |
| 20 | Pako (*Athyrium esculentum*) | do | 2.56 | -------- | -------- |
| 163 | Patola (*Luffa cylindrica*) | Green fruits | 2.96 | -------- | -------- |
| 23 | Perejil (*Petroselinum hortense*) | Leaves | -------- | 2.79 | 0.23 |
| 180 | Rutabaga (*Brassica napobrassica*) | do | 2.12 | 2.97 | 0.20 |
| 43 | Saluyot (*Corchorus olitorius*) | do | 1.89 | 2.59 | -------- |
| 21 | Sarsalida (*Mollugo oppositifolia*) | do | -------- | -------- | 0.36 |
| 41 | Sili (*Capsicum frutescens*) | do | -------- | 2.27 | -------- |
| 89 | Sitao (*Vigna sesquipedalis*) | Leaves and tops. | 2.27 | 2.33 | -------- |
| 45 | Sitau pula (*Vigna sesquipedalis*) | Green pods | 1.84 | -------- | -------- |
| 93 | American spinach (*Spinacea oleracea*) | Leaves | -------- | -------- | 0.72 |
| 59 | Indian spinach (*Rumex ambiguus*) | do | 1.82 | -------- | 0.48 |
| 46 | New Zealand spinach (*Tetragonia expansa*) | do | -------- | -------- | 0.47 |
| 56 | Prickly seeded spinach (*Spinacea oleracea*). | do | 2.11 | 2.54 | 0.13 |
| 85 | Squash, calabaza (*Cucurbita maxima*) | Leaves and tops. | 2.06 | 2.31 | 0.43 |
| 314 | Swiss chard (*Beta vulgaris* var. *cicla*) | Leaves | -------- | 4.65 | 0.15 |
| 109 | Tukod-langit (*Helminthostachys zeylanica.*) | Leaves and tops. | 2.33 | -------- | -------- |
| 344 | Tango (*Chrysanthemum coronarium*) | Leaves | -------- | -------- | 0.41 |
| 51 | Water cress (*Radicula nasturtium aquaticum.*) | Leaves and tops. | 2.13 | -------- | -------- |

TABLE 15.—*Distribution of ash, phosphorus, calcium, and iron in some very common (typical) types of Philippine food plants.*

| Name of plant. | Ash in dry sample.[a] | Phosphorus ($P_2O_5$) in— | | Calcium (CaO) in— | | Iron ($Fe_2O_3$) in— | |
|---|---|---|---|---|---|---|---|
| | | Dry sample. | Ash. | Dry sample. | Ash. | Dry sample. | Ash. |
| LEAFY VEGETABLES. | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Libato (*Basella rubra* L.) | 16.08 | 1.51 | 9.37 | 3.33 | 20.68 | 0.18 | 1.09 |
| Kolitis (*Amaranthus viridis* L.). | 19.64 | 1.99 | 10.11 | 3.63 | 18.50 | 0.42 | 2.16 |
| Petsai (*Brassica chinensis* L.) | 18.20 | 1.74 | 9.56 | 4.65 | 25.52 | 0.15 | 0.81 |
| Kamote [*Ipomoea batatas* (L.) Poir.] | 10.21 | 0.96 | 9.41 | 0.78 | 7.64 | 0.13 | 1.24 |
| Malungai (*Moringa oleifera* Lam.). | 13.64 | 1.16 | 8.52 | 3.47 | 25.42 | 0.52 | 3.82 |
| NONLEAFY VEGETABLES. | | | | | | | |
| Coconut cabbage (*Cocos nucifera* L.). | 17.80 | 2.06 | 11.59 | 1.43 | 8.04 | 0.04 | 0.20 |
| Bamboo shoot (*Bambus spinosa* Roxb.). | 10.67 | 2.12 | 19.87 | 0.36 | 3.42 | 0.02 | 0.19 |
| Squash flowers (*Cucurbita maxima* Duch.). | 16.70 | 2.86 | 17.10 | 1.05 | 6.30 | 0.12 | 0.73 |
| Patola [*Luffa cylindrica* (L.) M. Roem.]. | 13.50 | 2.39 | 17.71 | 0.81 | 6.01 | 0.06 | 0.41 |
| Banana heart [*Musa errans* (Blanco) Teodoro]. | 16.93 | 2.02 | 11.92 | 0.40 | 2.34 | 0.05 | 0.31 |
| FRUITS. | | | | | | | |
| Chico (*Achras zapota* L.) | 1.57 | 0.11 | 7.25 | 0.12 | 7.79 | 0.02 | 1.05 |
| Piña [*Ananas comosus* (L.) Merr.]. | 3.56 | 0.21 | 5.88 | 0.31 | 8.73 | 0.01 | 0.39 |
| Papaya (*Carica papaya* L.) | 3.75 | 0.29 | 7.67 | 0.11 | 2.91 | 0.01 | .35 |
| Naranjita (*Citrus nobilis* Lour.). | 3.62 | 0.46 | 12.81 | 0.20 | 5.45 | 0.01 | 0.22 |
| Mango (*Mangifera indica* L.). | 2.90 | 0.48 | 16.39 | 0.05 | 1.89 | 0.01 | 0.42 |
| SEEDS. | | | | | | | |
| Soy bean [*Glycine max* (L.) Merr.]. | 5.01 | 1.14 | 22.75 | 0.26 | 5.19 | 0.02 | 0.38 |
| Mungo (*Phaseolus aureus* Roxb.). | 4.17 | 1.02 | 24.46 | 0.47 | 11.27 | 0.01 | 0.24 |
| Polished rice (*Oryza sativa* L.). | 0.98 | 0.68 | 69.38 | 0.02 | 2.04 | 0.002 | 0.20 |
| Corn (*Zea mays* L.) | 1.46 | 0.65 | 44.52 | 0.08 | 5.48 | 0.01 | 0.48 |
| Peanut (*Arachis hypogaea* L.). | 2.62 | 1.15 | 43.89 | 0.33 | 12.59 | 0.003 | 0.11 |
| UNDERGROUND STRUCTURES. (ROOTS, TUBERS, RHIZOMES). | | | | | | | |
| Gabi (*Colocasia esculentum* Schott.). | 3.63 | 0.52 | 14.26 | 0.30 | 8.36 | 0.01 | 0.24 |
| Ube (*Dioscorea alata* L.) | 2.43 | 0.38 | 15.83 | 0.01 | 0.31 | 0.01 | 0.45 |
| Camote [*Ipomoea batatas* (L.) Poir.]. | 2.62 | 0.35 | 13.30 | 0.14 | 5.19 | 0.01 | 0.19 |
| Sincamas [*Pachyrrhizus erosus* (L.) Urb.]. | 4.15 | 0.45 | 10.85 | 0.39 | 9.33 | 0.03 | 0.65 |
| Radish (*Raphanus sativus* L.) | 18.49 | 1.73 | 9.35 | 1.22 | 6.61 | 0.11 | 0.60 |

[a] Dry sample refers to the moisture-free sample.

TABLE 16.—*Total ash and phosphorus, calcium, and iron contents in different parts of some Philippine food plants.*

[Percentages are based on moisture-free samples.]

| Sample No. | Name of plant. | Part of plant used. | Ash. | Phosphorus ($P_2O_5$). | Calcium (CaO). | Iron ($Fe_2O_3$). |
|---|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| 28 | Ampalaya (*Momordica charantia*). | Leaves | 18.77 | 1.37 | 4.36 | 0.47 |
| 12 | Do | Green fruits | 11.74 | 1.38 | 0.39 | 0.04 |
| 204 | Saba [*Musa sapientum* L. var. *compressa*]. | Heart | 16.93 | 2.02 | 0.40 | 0.05 |
| 223 | Do | Ripe fruits | 2.41 | 0.28 | 0.03 | 0.01 |
| 48 | Beet, remolacha (*Beta vulgaris*). | Leaves | 22.40 | 1.27 | 3.17 | 0.27 |
| 175 | Do | Petioles | 21.01 | 1.28 | 0.52 | 0.14 |
| 53 | Do | Roots | 13.58 | 1.42 | 0.16 | 0.03 |
| 41 | Bird pepper, sili (*Capsicum frutescens*). | Leaves | 14.45 | 1.11 | 2.27 | 0.11 |
| 151 | Do | Fruits | 8.12 | 1.25 | 0.35 | 0.04 |
| 158 | Cashew, kasoy (*Anacardium occidentale*). | Young leaves | 4.28 | 1.03 | 0.18 | 0.10 |
| 356 | Do | Mature seeds | 2.74 | 1.23 | 0.04 | 0.01 |
| 369 | Ciruelas (*Spondias purpurea*) | Young leaves | 7.20 | 0.92 | 2.18 | 0.05 |
| 116 | Do | Pulp of ripe fruits. | 3.92 | 0.78 | 0.08 | 0.02 |
| 86 | Gabi (*Colocasia esculentum*) | Corm (tuber) | 3.63 | 0.52 | 0.30 | 0.01 |
| 225 | Do | Leaves | 13.51 | 1.19 | 2.22 | 0.10 |
| 98-B | Do | Petioles | 19.24 | 1.65 | 1.43 | 0.08 |
| 40 | Malungai (*Moringa oleifera*) | Leaves | 13.64 | 1.16 | 3.47 | 0.52 |
| 181 | Do | Young pods | 14.45 | 1.93 | 0.14 | 0.05 |
| 244 | Nangka (*Artocarpus integra*) | Pulp of ripe fruits. | 3.52 | 0.24 | 0.12 | 0.002 |
| 247 | Do | Mature seeds | 2.96 | 0.54 | 0.13 | 0.004 |
| 327 | Sincamas (*Pachyrrhizus erosus*) | Young pods | 7.10 | 1.01 | 0.95 | 0.03 |
| 87 | Do | Fleshy roots | 4.15 | 0.45 | 0.39 | 0.03 |
| 39 | Sitao (*Vigna sesquipedalis*) | Leaves and tops. | 15.05 | 2.27 | 2.33 | 0.12 |
| 17 | Do | Young pods | 7.85 | 1.47 | 0.84 | 0.04 |
| 35 | Squash, calabasa (*Cucurbita maxima*). | Leaves and tops. | 17.34 | 2.06 | 2.31 | 0.43 |
| 301 | Do | Flowers | 16.70 | 2.86 | 1.05 | 0.12 |
| 141 | Do | Fruits | 9.96 | 1.08 | 0.43 | 0.06 |
| 29 | Sweet potato, camote (*Ipomoea batatas*). | Leaves and tops. | 10.21 | 0.96 | 0.78 | 0.13 |
| 154 | Do | Tuber | 2.12 | 0.38 | 0.08 | 0.01 |
| 172 | Tamarind, sampalok (*Tamarindus indica*). | Young leaves | 4.50 | 1.21 | 0.22 | 0.02 |
| 113 | Do | Flowers | 4.14 | 0.75 | 0.20 | 0.05 |
| 27 | Do | Young fruits | 4.52 | 0.53 | 1.03 | 0.01 |
| 281 | Do | Pulp of ripe fruits. | 6.08 | 0.53 | 0.20 | 0.02 |

TABLE 17.—*Analyses of certain leafy vegetables collected at the same or different localities.*

| Sample No. | Common name of plant. | Date of collection (1932). | | Place of collection. | Total ash.[a] | In per cent of total ash. | | | CaO:$P_2O_5$. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $P_2O_5$. | CaO. | $Fe_2O_3$. | |
| | | | | | *Per cent.* | | | | |
| 8 | Himbaba-ó | Mar. | 28 | Manila | 11.08 | 13.24 | 14.35 | 1.05 | 1:0.92 |
| 8-A | Do | June | 2 | do | 15.19 | 9.32 | 12.53 | 0.81 | 1:0.74 |
| 18 | Cuchai | Apr. | 6 | do | 16.09 | 10.81 | 9.61 | 0.86 | 1:1.12 |
| 18-A | Do | May | 30 | Baguio | 15.62 | 8.87 | 6.46 | 0.77 | 1:1.37 |
| 9 | Kinchai | Mar. | 31 | Manila | 14.71 | 7.61 | 16.63 | 0.74 | 1:0.46 |
| 9-A | Do | July | 4 | Baguio | 14.98 | 9.66 | 20.03 | 0.84 | 1:0.48 |
| 20 | Pako | Apr. | 6 | Manila | 13.15 | 19.46 | 1.89 | 0.47 | 1:10.3 |
| 20-A | Do | May | 23 | Baguio | 13.25 | 15.65 | 2.38 | 0.37 | 1:6.58 |
| 11 | Libato | Apr. | 2 | Manila | 16.08 | 9.37 | 20.68 | 1.09 | 1:0.45 |
| 11-A | Do | June | 2 | do | 16.01 | 11.20 | 12.93 | 0.87 | 1:0.87 |
| 6 | Mostaza | Mar. | 28 | do | 15.96 | 13.93 | 15.50 | 1.14 | 1:0.90 |
| 6-A | Do | June | 8 | Baguio | 23.02 | 8.26 | 12.36 | 1.12 | 1:0.67 |
| 4 | Koles | Mar. | 26 | Manila | 16.54 | 10.07 | 30.47 | 0.87 | 1:0.33 |
| 4-A | Do | Nov. | 15 | Baguio | 16.02 | 11.02 | 28.57 | 1.36 | 1:0.39 |
| 25 | Repollo | Apr. | 11 | Manila | 8.42 | 11.19 | 10.93 | 0.36 | 1:1.02 |
| 25-A | Do | May | 26 | Baguio | 8.84 | 10.23 | 9.98 | 0.38 | 1:1.03 |
| 43 | Saluyot | May | 19 | Manila | 14.61 | 12.97 | 17.74 | 0.50 | 1:0.73 |
| 43-A | Do | June | 2 | Baguio | 13.31 | 10.13 | 17.75 | 0.92 | 1:0.57 |
| 29 | Camote | Apr. | 18 | Manila | 10.21 | 9.41 | 7.64 | 1.24 | 1:1.23 |
| 29-A | Do | June | 6 | Baguio | 12.72 | 10.75 | 6.49 | 1.49 | 1:1.66 |
| 2 | Kangkong | Mar. | 23 | Manila | 12.18 | 14.42 | 4.96 | 1.29 | 1:2.91 |
| 2-A | Do | May | 16 | do | 12.59 | 15.89 | 6.55 | 1.00 | 1:2.43 |
| 2-B | Do | June | 15 | do | 11.78 | 13.30 | 7.16 | 0.95 | 1:1.86 |
| 23 | Perejil | Apr. | 8 | do | 15.90 | 8.12 | 17.55 | 1.42 | 1:0.46 |
| 23-A | Do | June | 6 | Baguio | 15.53 | 8.55 | 13.96 | 2.02 | 1:0.61 |

[a] The percentage of total ash is based on the moisture-free sample.

TABLE 18.—*Vegetables and fruits having a calcium oxide-phosphorus pentoxide ratio of approximately 1 : 3.*

| Sample No. | Name of plant. | Part used. | Phosphorus ($P_2O_5$) in ash. | Calcium (CaO) in ash. | Ratio CaO: $P_2O_5$. |
|---|---|---|---|---|---|
| | | | *Per cent.* | *Per cent.* | |
| 16 | Alibangbang | Leaves | 17.96 | 6.50 | 1 · 2.7 |
| 211 | Cauliflower | Leaves and flower heads | 16.80 | 6.15 | 1 · 2.7 |
| 331 | Buyok-buyok | Leaves | 21.61 | 6.19 | 1 : 3.5 |
| 132 | Chayote | do | 20.45 | 6.09 | 1 : 3.3 |
| 89 | Sili | do | 14.72 | 5.71 | 1 : 2.6 |
| 301 | Calabaza | Leaves and top | 17.10 | 6.30 | 1 : 2.7 |
| 22 | Chicharo | Green pods | 26.87 | 10.12 | 1 : 2.7 |
| 245 | Sibuyas | Leaf bases | 22.63 | 6.83 | 1 : 3.3 |
| 172 | Ates | Fruits | 16.50 | 5.69 | 1 : 2.8 |
| 273 | Chico mamey | do | 6.94 | 2.32 | 1 : 3.0 |
| 317 | Chinese sapote | do | 10.11 | 3.63 | 1 : 2.8 |
| 167 | Makopa | do | 13.95 | 4.87 | 1 : 2.8 |
| 170 | Santol | do | 4.47 | 1.45 | 1 : 3.1 |
| 195 | Apricot | do | 14.90 | 4.56 | 1 : 3.2 |
| 275 | Susong calabao | do | 8.41 | 2.63 | 1 : 3.2 |
| 254 | Chinese carrot | Root | 14.96 | 4.51 | 1 : 3.3 |
| 177 | Sweet potato | do | 11.45 | 4.38 | 1 : 2.6 |
| 259 | American parsnip | do | 18.18 | 5.63 | 1 : 3.2 |
| 346 | Japanese radish | do | 10.30 | 3.78 | 1 : 2.7 |

TABLE 19.—*Some common Philippine vegetables that have a comparatively high calcium and low phosphorus content.*

[Percentages were calculated on the moisture-free samples.]

| Sample No. | Common name of plant. | Ash. | Phosphorus ($P_2O_5$). | Calcium (CaO). | Ratio CaO:$P_2O_5$. |
|---|---|---|---|---|---|
| | | *Per cent.* | *Per cent.* | *Per cent.* | |
| 159 | Kudiapa | 18.69 | 1.40 | 3.67 | 1 : 0.4 |
| 1 | Kolitis | 19.64 | 1.99 | 3.63 | 1 : 0.5 |
| 9 | Kinchai | 14.71 | 1.12 | 2.45 | 1 : 0.5 |
| 11 | Libato | 16.08 | 1.51 | 3.33 | 1 : 0.5 |
| 48 | Beet | 22.40 | 1.27 | 3.17 | 1 : 0.4 |
| 314 | Swiss chard | 20.27 | 0.73 | 3.14 | 1 : 0.2 |
| 10 | Petsai | 18.20 | 1.74 | 4.65 | 1 : 0.4 |
| 237 | Mustard | 18.94 | 1.90 | 3.30 | 1 : 0.6 |
| 4 | Koles | 16.54 | 1.67 | 5.04 | 1 : 0.3 |
| 41 | Sili | 14.45 | 1.11 | 2.27 | 1 : 0.5 |
| 225 | Gabi | 13.51 | 1.19 | 2.22 | 1 : 0.5 |
| 14 | Ongsoy | 10.69 | 1.16 | 2.56 | 1 : 0.5 |
| 27 | Lettuce | 17.55 | 1.60 | 2.78 | 1 : 0.5 |
| 28 | Ampalaya | 18.77 | 1.37 | 4.36 | 1 : 0.3 |
| 23 | Perejil | 15.90 | 1.29 | 2.79 | 1 : 0.5 |

TABLE 20.—*Leaves of vegetables rich in iron.*

[Average moisture content about 87 per cent.]

| Sample No. | Common name of vegetable. | Milligrams of iron ($Fe_2O_3$) in 100 grams of fresh vegetables. | Sample No. | Common name of vegetable. | Milligrams of iron ($Fe_2O_3$) in 100 grams of fresh vegetables. |
|---|---|---|---|---|---|
| 8 | Himbaba-6 | 30 | 109 | Tukod-langit | 15 |
| 19 | Sibuyas | 11 | 29 | Kamote | 20 |
| 18 | Kuchai | 12 | 2–A | Kangkong | 13 |
| 182 | Halon | 17 | 27 | Lechugas | 20 |
| 1 | Kolitis | 45 | 320 | Kamoteng-kahoy | 11 |
| 158 | Kasoy | 25 | 21 | Malagoso | 30 |
| 9 | Kinchai | 15 | 28 | Ampalaya | 64 |
| 11 | Libato | 17 | 331 | Buyok-buyok | 14 |
| 16 | Alibangbang | 14 | 40 | Malungai | 10 |
| 48 | Remolacha | 35 | 23 | Perejil | 39 |
| 314 | Swiss chard | 13 | 335 | Kapilan | 14 |
| 6 | Mostaza | 16 | 137 | Pokeweed | 13 |
| 180 | Rutabaga | 23 | 315 | Japanese plantain | 24 |
| 4 | Koles | 16 | 51 | Water cress | 15 |
| 41 | Siling labuyo | 21 | 59 | Indian spinach | 13 |
| 387 | Water fern | 12 | 56 | Prickly-seeded spinach | 17 |
| 344 | Tung-hao | 25 | 369 | Ciruelas | 13 |
| 107 | Boboy | 13 | 46 | New Zealand spinach | 37 |
| 225 | Gabi | 23 | 119 | Toston | 67 |
| 43 | Saluyot | 13 | 332 | Sintas-sintasan | 11 |
| 14 | Coriander | 16 | 39 | Sitao | 14 |
| 36 | Bago | 10 | 336 | Seguidillas (green pods) | 17 |

# THE PHILIPPINE SPECIES OF SELAGINELLA

By A. H. G. Alston

*Of the British Museum (Natural History), London*

TWO PLATES

Work on this revision was originally started with the material at the British Museum (Natural History) and a loan from Dr. E. B. Copeland which included both the specimens in his private herbarium and those belonging to the University of California. Later portions of the Philippine collections at Kew, Washington, New York, and Manila were sent on loan. The author wishes to thank Doctor Copeland and the directors of the above institutions for the help thus given.

The chief difficulty has been the large number of species described by Hieronymus; twenty-eight of these have been reduced to synonymy; besides these "species" Hieronymus has scattered a vast number of manuscript names in various herbaria, none of which have been taken up or quoted. In spite of this great reduction in the number of names, it is probable that the process has not been carried far enough, as a number of somewhat dubious species have been retained. In this connection the attention of field workers is especially drawn to the large erect species, Nos. 31 to 46, where further material is most likely to lead to modifications of the taxonomy.

The distribution of the species within the Archipelago and the floristic relations indicated by their range outside is of considerable interest. Two species show a connection with China and Japan. *Selaginella Möllendorffii* Hieron. and *S. boninensis* Bak. are found, as might be expected, in the northern part of the Archipelago. Some species show connections with Borneo and Celebes, especially the latter. It is probable that some of the Philippine species will have to be reduced to Borneo species; the author hopes to deal with this in a later paper, on the Borneo species.

*Key to the Philippine species of Selaginella.*

Leaves dimorphic throughout.
    Sporophylls uniform; cones tetragonous.
        Plants xerophytic; stem curling up when dried.
            1. *S. tamariscina.*

  - Plants not xerophytic.
    - Lateral leaves all spreading, often contiguous, usually denticulate or ciliate; stems usually prostrate or ascending.
      - Stems pubescent .......................................... 27. *S. biformis.*
      - Stems glabrous.
        - Stems not scandent.
          - Axillary leaves not auriculate.
            - Lateral leaves ovate-lanceolate.
              - Lateral leaves ciliate, contiguous. 2. *S. repanda.*
              - Lateral leaves denticulate, distant. 3. *S. remotifolia.*
            - Lateral leaves oblong-lanceolate, separated by less than their breadth.
              - Stems prostrate.
                - Lateral leaves ciliate. 4. *S. Springiana.*
                - Lateral leaves denticulate. 5. *S. negrosensis.*
              - Stems suberect................. 6. *S. ascendens.*
          - Axillary leaves auriculate.......... 7. *S. auriculata.*
        - Stems climbing by means of short rhizophores.
          - Median leaves obtuse................ 8. *S. Cumingiana.*
          - Median leaves aristate.................... 9. *S. alligans.*
    - Lateral leaves of main stem distant, ascending, entire or subentire; stems ascending or scandent, usually pleiostelic.
      - Median leaves margined.
        - Axillary leaves not auricled ............ 10. *S. delicatula.*
        - Axillary leaves auricled; auricles laciniate. 11. *S. lacerata.*
      - Median leaves not margined.
        - Axillary leaves not auriculate, overlapping the branches ........................................ 12. *S. gastrophylla.*
        - Axillary leaves auriculate, auricles entire.
          - Stems ascending, straight, ovate-oblong in cross section, usually tripinnate; steles normally 7. 13. *S. Usterii.*
          - Stems scandent, flexuose, usually subterete, quadripinnate; steles normally 3 to 5. 14. *S. Engleri.*
- Sporophylls dimorphic; cones flattened.
  - Main stems creeping, rooting at intervals.
    - Stems under 4 mm broad (including leaves).
      - Lateral leaves ovate, scarcely longer than broad.
        - Lateral leaves not ciliate at base....15. *S. nummularia.*
        - Lateral leaves ciliate at base............16. *S. intertexta.*
      - Lateral leaves much longer than broad.
        - Lateral leaves contiguous.................... 17. *S. apoensis.*
        - Lateral leaves distant ........................... 18. *S. ciliaris.*

Stems about 6 mm broad (including leaves).

Sporophylls of upper series narrowly lanceolate; rhizophores filiform ........................................ 19. *S. boninensis.*

Sporophylls ovate-lanceolate; rhizophores robust. 20. *S. opaca.*

Main stems erect, rooting at base.

Stems up to 8 mm across, including leaves.......... 21. *S. ornata.*

Stems under 8 mm across, including leaves.

Median leaves acute, not aristate; stems not stoloniferous; lateral leaves ciliolate at base.

Lateral leaves ovate; stems simple below. 22. *S. Llanosii.*

Lateral leaves elliptic-lanceolate; stems branched from the base .................................. 23. *S. philippina.*

Median leaves aristate.

Lower sporophylls and lateral leaves ciliate.

Stems stoloniferous ................ 24. *S. myosuroides.*

Stems not stoloniferous.................. 22. *S. Llanosii.*

Lower bracts and lateral leaves denticulate; stems not stoloniferous.

Median leaves elliptic; arista as long as lamina. 25. *S. aristata.*

Median leaves broadly ovate; arista half as long as lamina ............................ 26. *S. Eschscholzii.*

Leaves uniform at base of erect stems.

Stems pubescent, quadrangular............................................ 27. *S. biformis.*

Stems glabrous.

Stems terete; leaves drying light green; median leaves shortly cuspidate; lateral leaves with false nerves.

Median leaves not margined.

Outer half of median leaves broader than inner half; lateral leaves ovate-lanceolate........................ 28. *S. polyura.*

Outer half of median leaves equaling the inner half; lateral leaves ovate-oblong............................ 29. *S. peltata.*

Median leaves white-margined; stems quadrangular at base. 30. *S. Möllendorffii.*

Stems irregularly angled or compressed; leaves usually drying dark green above.

Axillary leaves ovate, not auriculate.

Median leaves acute, not aristate.

Sporophylls aristate; lateral leaves up to 8 mm long. 31. *S. magnifica.*

Sporophylls acute; lateral leaves up to 6 mm long. 32. *S. procera.*

Median leaves long-aristate.

Median leaves white-margined.... 30. *S. Möllendorffii.*

Median leaves not margined.

Lateral leaves strongly ciliate at base. 40. *S. Jagorii.*

Lateral leaves entire or ciliolate at base.

Lateral leaves strongly dimorphic at base of branches, leaves drying dark green above. 33. *S. Elmeri.*

Lateral leaves only slightly dimorphic at base of branches; leaves drying dark green above.

Lateral leaves of ultimate branchlets overlapping, lanceolate. 34. *S. latifrons.*

Lateral leaves of ultimate branchlets laxer, ovate-lanceolate. 35. *S. agusanensis.*

Axillary leaves lanceolate, often auriculate and ciliate at base.

Leaves erect, subequal throughout the lower two-thirds of the erect stems.

Median leaves long-aristate; arista at least one-third as long as lamina.

Lateral leaves narrowed towards the base, broadest near the middle .......... 44. *S. luzonensis.*

Lateral leaves rounded and broadest at base.

Lateral leaves up to 6 mm long, about three times as long as broad .......... 36. *S. Copelandii.*

Lateral leaves up to 4.5 mm long, about twice as long as broad.

Arista of median leaves as long as lamina; lateral leaves oblong-lanceolate .......... 37. *S. Ramosii.*

Arista of median leaves about half as long as lamina; lateral leaves oblong-ovate .......... 38. *S. Neei.*

Median leaves acuminate or shortly aristate.

Ultimate branchlets 10 mm across (including leaves). 31. *S. magnifica.*

Ultimate branchlets up to 5 mm across.

Median leaves of main stem closely ciliolate. 39. *S. Fenixii.*

Median leaves entire or denticulate.

Lateral leaves shining, closely imbricate; sporophylls acuminate .......... 45. *S. flabelloides.*

Lateral leaves not shining, laxer; sporophylls subacute. 46. *S. cupressina.*

Leaves spreading and strongly dimorphic almost to base of erect stems.

Median leaves long-aristate; arista at least one-third as long as lamina .......... 40. *S. Jagorii.*

Median leaves acuminate or shortly-aristate.

Largest lateral leaves 6 mm long.......... 41. *S. halconensis.*

Largest lateral leaves 4 mm long.

Lateral leaves contiguous.......... 42. *S. aenea.*

Lateral leaves distant.......... 43. *S. Presliana.*

### 1. SELAGINELLA TAMARISCINA (Beauv.) Spring.

*Selaginella tamariscina* (Beauv.) SPRING in Bull. Ac. Brux. 10 (1843) 136.
*Stachygynandrum tamariscinum* BEAUV., Prod. (1805) 106.
? *Lycopodium involvens* SW., Syn. Fil. (1806) 182.
*Selaginella circinalis* "(L.)" PRESL, Bot. Bern. (1844) 153.
*Selaginella convolvens* V. A. V. R. in Bull. Jard. Bot. Buitenz. II 11 (1923) 23.

Philippines, without exact locality, *Cuming 1997, 2001.* LUZON, Cagayan Province, Mount Cura, *For. Bur. 16838 Curran:* Ilocos Norte Province, Mount Nagapatan, *Bur. Sci. 33226 Ramos:* Bontoc Subprovince, Bauco, *Vanoverbergh 426:* Benguet Subprovince, Trinidad, *Williams 1597;* Mount Pulog, *Merrill 6389:* Zambales Province, Mount Tapolao, *Bur. Sci. 5123 Ramos, 44755 Ramos and Edaño:* Bataan Province, upper Lamao River, *Williams 785:* Rizal Province, Susong Dalaga, *Bur. Sci. 13602 Ramos, 19244 Reillo:* Laguna Province, Mount Banahao, *For. Bur. 7994 Curran and Merritt:* Batangas Province, Mount Batulao, *Bur. Sci. 22338 Ramos.*

*Geographical range.*—China and Japan, reported from Celebes.

### 2. SELAGINELLA REPANDA (Desv.) Spring.

*Selaginella repanda* (Desv.) SPRING in Gaudich. Voy. Bonite Bot. 1 (1844–1846) 329.
*Selaginella barbata* (Kaulf.) SPRING in Bull. Ac. Brux. 10 (1843) 226.
*Lycopodium repandum* DESV. ex Poir., Encycl. Suppl. 3 (1814) 558.
*Lycopodium barbatum* KAULF., Enum. Fil. (1824) 181.
*Selaginella ceratocaulos* V. A. V. R. in Bull. Jard. Bot. Buitenz. II 16 (1914) 41.

Philippines, without exact locality, *Cuming 2014* (in herb. Desvaux). LUZON, Apayao Subprovince, *Bur. Sci. 28262 Fénix:* Bontoc Subprovince, Mount Masapilid, *Bur. Sci. 38243 Ramos and Edaño:* Nueva Vizcaya Province, Dupax, *Bur. Sci. 20142, 20137 McGregor:* Nueva Ecija Province, Mount Umingan, *Bur. Sci. 26277 Ramos and Edaño:* Bulacan Province, Angat, *Bur. Sci. 21670 Ramos:* Manila, *Merrill 7112, 7124:* Rizal Province, Montalban, *Merrill 7123, Bur. Sci. 9540 Robinson, Loher 1317;* Nawa, *Topping 1013, 1047;* Tanay, *Bur. Sci. 11880 Robinson and Ramos;* Antipolo, *Bur. Sci. 29531 Ramos and Edaño.* PANAY, Tigorn River, *Bur. Sci. 18109 Robinson.*

*Geographical range.*—Indo-Malayan.

**3. SELAGINELLA REMOTIFOLIA Spring.**

*Selaginella remotifolia* SPRING in Miq. Pl. Jungh. 3 (1854) 276.

LUZON, Benguet Subprovince, Baguio, *Merrill 7738, 7798, 7731;* Baguio, *Elmer 14301;* Pauai, *Copeland:* Rizal Province, Montalban, *Loher 975.*

*Geographical range.*—Java, Sumatra (type locality), China, Formosa, and Japan.

This species is very similar to the African *S. Kraussiana* (Kze.) A. Br. and has been united with it by some authors.

**4. SELAGINELLA SPRINGIANA v. A. v. R.**

*Selaginella Springiana* v. A. v. R. in Bull. Jard. Bot. Buitenz. II 11 (1913) 28.

PALAWAN, Iwahig River, *Merrill 714.* MINDANAO, Zamboanga district, *Bur. Sci. 36841 Ramos and Edaño.*

*Geographical range.*—Sumatra and Borneo.

**5. SELAGINELLA NEGROSENSIS Hieron.**

*Selaginella negrosensis* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2007.

*Selaginella Perkinsiae* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2610.

PANAY, Capiz Province, Kinablangan, *Bur. Sci. 46066 Edaño:* Capiz Province, Libucao, *Bur. Sci. 31434 Ramos and Edaño.* NEGROS, Dumaguete, Cuernos Mountains, *Elmer 10231* (type of *Selaginella negrosensis*). MINDANAO, Todaya, Mount Apo, *Elmer 11847* (type of *Selaginella Perkinsiae*).

*Geographical range.*—Philippines (Panay, Negros, and Mindanao).

**6. SELAGINELLA ASCENDENS v. A. v. R.**

*Selaginella ascendens* v. A. v. R. in Bull. Jard. Bot. Buitenz. II 11 (1913) 33.

PALAWAN, San Antonio Bay, *Merrill 834.* JOLO, *Burbidge s. n.*

*Geographical range.*—Borneo, Celebes, Sumatra, Java, and Malay Peninsula.

**7. SELAGINELLA AURICULATA Spring.**

*Selaginella auriculata* SPRING in Bull. Ac. Brux. 10 (1843) 142.

*Lycopodium atrovirens* PRESL, Rel. Haenk. 1 (1825) 79, *t. 12, f. 2.* non *S. atrovirens* Lojacono Pojero.

*Selaginella amphylotis* A. BR. in Ann. Sci. Nat. 3 (1865) 274.

*Selaginella plumosa* var. *gracilis* PRESL, Bot. Bem. (1844) 153.

Philippines, without exact locality, *Cuming 2013* (type). LUZON, Cagayan Province, Sitio Viola, *For. Bur. 19582 Curran, Bur. Sci. 13889, 14543, 14545 Ramos, 16648 Bacani;* Abulug River, *Weber 1580, 1569;* Tamdagan River, *Bur. Sci. 79646 Edaño;* Claveria, *Bur. Sci. 10738 McGregor:* Ilocos Norte Province, Bangui to Claveria, *Bur. Sci. 33065 Ramos.*

*Geographical range.*—Northern Luzon.

Haenke's locality "Cordilleras de Chile" was doubtless a mistake.

### 8. SELAGINELLA CUMINGIANA Spring.

*Selaginella Cumingiana* SPRING in Bull. Ac. Brux. 10 (1843) 146.
*Selaginella Cumingiana* var. *simplici-ramosa* SPRING in Mem. Ac. Belg. 24 (1850) 127.

Philippines, without exact locality, *Cuming 2011, 2012* (type). LUZON, Rizal Province, Montalban, *Loher 12786.* MINDORO, Binabay River, *Merrill 6014;* Puerto Galera, *Kienholz 15201;* Mount Tablagun, *Merritt 11007.* LEYTE, *Wenzel 381.* SAMAR, Catubig River, *Bur. Sci. 24834 Edaño.* MINDANAO, Davao Province, Mount Mayo, *Bur. Sci. 49591 Ramos and Edaño:* Surigao Province, Placer, *Wenzel 3435.*

*Geographical range.*—Philippine Islands.

### 9. SELAGINELLA ALLIGANS Hieron.

*Selaginella alligans* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2012.

LUZON, Isabela Province, Mount Moises, *Clemens 16544:* Rizal Province, Montalban, *Loher 12057;* Angcolog, *Loher s. n.;* Helugan River, *Loher 12887:* Laguna Province, Helugan River, *For. Bur. 19270 Curran;* San Antonio, *Bur. Sci. 12084, 20598 Ramos;* Pasto, *Bur. Sci. 10040 Ramos:* Tayabas Province, Lucban, *Elmer 9271, 7982;* Infanta, *Bur. Sci. 9366* Robinson; Mount Banahao, *For. Bur. 927 Whitford:* Camarines Sur Province, Mount Isarog, *Bur. Sci. 76540 Edaño:* Sorsogon Province, Irosin, (Mount Bulusan), *Elmer 16073.* CATANDUANES, *Bur. Sci. 30235 Ramos.* MINDANAO, Surigao Province, Diuata Mountains, *Bur. Sci. 83463 Ramos and Convocar.*

*Geographical range.*—Philippine Islands and Celebes (?).

Hieronymus quotes *Elmer 7124, 7982, 8001, Jagor 791,* and *Weber 1489* without distinguishing a type. *Wenzel 410* probably belongs here; the median leaves are more shortly acuminate.

Elmer (*7982*) notes "scandent upon shrubs and forming rather tangled masses some 15 ft. from the ground."

### 10. SELAGINELLA DELICATULA (Desv.) Alston.

*Selaginella delicatula* (Desv.) ALSTON in Journ. Bot. 70 (1932) 282.
*Lycopodium delicatulum* DESV. ex Poir., Encycl. Suppl. 3 (1814) 584.
*Lycopodium Pouzolzianum* GAUD. in Freyc. Voy. Bot. 1 (1826) 287.
*Selaginella Pouzolziana* (Gaud.) SPRING in Bull. Ac. Brux. 10 (1843) 145.
*Selaginella pectinata* PRESL, Bot. Bem. (1844) 153.
*Selaginella Pouzolziana philippinensis* HIERON. in Engl. and Prantl Nat. Pfl. 4 (1901) 701.
*Selaginella Pouzolziana punctata* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2049, 2050.
*Selaginella Pouzolziana typica* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2049.
*Selaginella davaoensis* HIERON. in Elm. Leafl. Philip. Bot. 6 (1913) 2053.

Philippines, without exact locality, *Cuming 1995, Wallis 114.* BATAN, Batanes Province, Santo Domingo de Basco, *Bur. Sci. 3667 Fenix, Bur. Sci. 10196 McGregor.* LUZON, Cagayan Province, Peñablanca, *Bur. Sci. 27191 Ramos:* Benguet Subprovince, *Merrill 7727, 7739;* Baguio, *Topping 228, 328;* Sablan Trail, *Topping 1099:* Nueva Vizcaya Province, Bayombong, *Bur. Sci. 8165 Ramos:* Pampanga Province, Mount Pinatubo, *Elmer 22009, 22129:* Laguna Province, Mount Maquiling, *For. Bur. 26113 Mabesa;* Los Baños, (Mount Maquiling), *Elmer 18074, 18384, Merrill 5111, 619, Copeland 12, 2013, Topping 945;* Mount Banahao, *Bur. Sci. 9769 Robinson;* Los Baños, *Topping 709, 677;* Pagsanjan, *Topping 511, 997;* Majayjay, *Topping 983:* Tayabas Province, Lucban, *Elmer 7918, Bur. Sci. 47361 McGregor;* Mount Banahao, *For. Bur. 974 Whitford:* Sorsogon Province, Irosin, (Mount Bulusan), *Elmer 16876.* MINDORO, *Merrill 12037.* LEYTE, Jaro, *Wenzel 635.* MINDANAO, Davao Province, Todaya (Mount Apo), *Elmer 11586:* Lanao Province, Lanao district, *For. Bur. 25270, 25275 Alvarez.* SULU IS., *Burbidge.*

*Geographical range.*—Indo-Malayan.

Hieronymus compares his *Selaginella davaoensis* with *Selaginella Wallichii* (Hk. and Gr.) Spring but not with this species; it appears to be simply a denser form.

### 11. SELAGINELLA LACERATA Warb.

*Selaginella lacerata* WARB. in Monsunia 1 (1900) 106, 120.
*Selaginella pectinata* var. *acutissima* PRESL, Bot. Bem. (1844) 153.
*Selaginella cyatheoides* SPRING in Bull. Ac. Brux. 10 (1843) 145.

Philippines, without exact locality, *Cuming 2010* (type). PANAY, Capiz Province, Mount Dilana, *Bur. Sci. 46055 Edaño;* Libucao, *Bur. Sci. 35505 Martelino and Edaño:* Iloilo Province, Tigom River, *Bur. Sci. 18124;* Ulian River, *Bur. Sci. 18171 Robinson:* Antique Province, Culasi, *Bur. Sci. 32222 McGregor.* NEGROS, Gimogon River, *Copeland 61;* Dumaguete, *Elmer 9984, 10346.*

*Geographical range.*—Confined to Panay and Negros.

*Selaginella plana* (Desv.) Hieron., *Topping 1049,* was collected near Manila; it was doubtless an escape from cultivation.

### 12. SELAGINELLA GASTROPHYLLA Warb.

*Selaginella gastrophylla* WARB. in Monsunia 1 (1900) 107, 121, *t. 4, f. D.*

MINDANAO, Zamboanga Province, Mount Dagatpan, *Warburg 14192a:* Lanao Province, Lake Lanao, *Clemens s. n.;* Taraca River, *Mearns s. n.;* between Malabang and Lake Lanao, *Bartsch 459:* Zamboanga Province, Malangas, *Bur. Sci. 36826 Ramos and Edaño;* Pantar, *Mearns 116.*

*Geographical range.*—Mindanao and Borneo ?. Warburg quotes also Sanguir Islands, *Warburg 16603.*

Probably the same as *Selaginella conferta* Moore from Borneo.

### 13. SELAGINELLA USTERII Hieron.

*Selaginella Usterii* HIERON. ex Usteri Beitr. Phil. Veg. (1905) 135; in Vierteljahresschr. Nat. Ges. Zürich 50 (1906) 475; in Elm. Leafl. Phil. Bot. 6 (1913) 2055.

*Lycopodium chilense* "Willd.;" PRESL, Rel. Haenk. 1 (1825) 79.

*Selaginella Pouzolziana* "Spring;" BRACK., U. S. Expl. Exped. (1854) 333.

LUZON, Laguna Province, Mount Banahao, *Bur. Sci. ? Yates:* Tayabas Province, Kabibihan, *Bur. Sci. 13249 Ramos:* Camarines Sur Province, Botol River, *Bur. Sci. 76500 Edaño;* Paracale, *Bur. Sci. 33553 Ramos and Edaño;* Pasacao, *Merrill 3368:* Sorsogon Province, Irosin (Mount Bulusan), *Elmer 16069, 15454.* CATANDUANES, *Bur. Sci. 75680 Ramos and Edaño.* MASBATE, *Merrill 2749.* CEBU, Mount Limusan, *Bur. Sci. 11037 Ramos.* BOHOL, Bilar, *Bur. Sci. 42989 Ramos.* BILIRAN, *Bur. Sci. 18659 McGregor.* LEYTE, Dagami, *Wenzel 391, 81, 50, For. Bur. 16919 Whitford;* Palo, *Elmer 7065;* Tacloban, *Copeland 96.* SAMAR, Loquilocon, *Bur. Sci. 43768, 43720, 43784 McGregor;* Catubig River, *Merrill 5202.* SIARGAO, *Bur. Sci. 35023 Ramos and Pascasio.* MINDANAO, Davao Province, Todaya (Mount Apo), *Elmer 10969;* Mati, *Bur. Sci. 49339 Ramos and Edaño;* Davao district, *Bur. Sci. 15855 Fenix:* Agusan Province, Cabadbaran (Mount Urdaneta), *Elmer 13365, 13385, 14312;* Paz, *Weber 1199, Bur. Sci. 15895 Fenix:* Zamboanga Province, Zamboanga district, *Merrill 8241;* Malangas, *Bur. Sci. 36753, 36826 Ramos* *and Edaño;* Santa Maria, *Bur. Sci. 16449 Reillo:* Bukidnon Province, Tangkulan, *Bur. Sci. 26146 Fenix:* Cotabato Province, Reina Regente, *Bur. Sci. 11648 Robinson;* near Fort Caldera, *Brackenridge 6.* SULU, *Burbidge s. n.*

*Geographical range.*—Southern Luzon southwards to the Sulu Islands.

Elmer (No 7065) notes, "often 1 meter high and branched; stems wiry; very common near sea-level." Very similar species are found in Celebes and the Moluccas.

### 14. SELAGINELLA ENGLERI Hieron.

*Selaginella Engleri* HIERON. in Engl. and Prantl Nat. Pfl. 1 (1901) 704.

*Selaginella Whitfordii* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2061.

LUZON, Apayao Subprovince, Tauit, *Worcester 10754, Bur. Sci. 28169 Fenix;* Abulug-Narig Trail, *Weber 1551:* Cagayan Province, Sitio Viola, *For. Bur. 19584, 19586 Curran, Bur. Sci. 7548, 13803 Ramos;* Tamdagan River, *Bur. Sci. 79647 Edaño;* Gonzaga River, *Bur. Sci. 78684 Edaño:* Laguna Province, Pagsanjan, *Copeland 11, 1990;* Mani, *Wichura 1930;* Majayjay, *Topping 978:* Tayabas Province, Atimonan, *For. Bur. 626 Whitford;* Lucban, *Elmer 7919;* Casiguran, *Bur. Sci. 45390 Ramos and Edaño, Mearns 2985;* between Malicboy and Atimonan, *Topping 1317;* Tagcauayan, *Bur. Sci. 13344 Ramos;* Mount Banahao, *For. Bur. Whitford 969:* Camarines Sur Province, Mount Madooy, *Bur. Sci. 75791 Edaño:* Sorsogon Province, Irosin (Mount Bulusan), *Elmer 15454, 16069.* POLILLO, *Bur. Sci. 6907 Robinson, Bur. Sci. 10293 McGregor.* CATANDUANES, *Bur. Sci. 75670 Ramos and Edaño;* Mount Mareguidon, *Bur. Sci. 30305 Ramos.* ALABAT, *Bur. Sci. 48370 Ramos and Edaño.* MINDORO, Alag River, *Merrill 6016;* Paluan, *Bur. Sci. 39663 Ramos;* Baco River, *Merrill 1805.* PANAY, Capiz Province, Mount Timbaban, *Bur. Sci. 42345 Edaño;* Mount Ditana, *Bur. Sci. 46074 Edaño;* Jamindan, *Bur. Sci. 31070 Ramos and Edaño;* Libucao, *Bur. Sci. 35292 Martelino and Edaño.* NEGROS, Dumaguete (Cuernos Mountain), *Elmer 9617;* Mount Canlaon, *Merrill 8026;* Gimagaan River, *For. Bur. 1663 Whitford.* LEYTE, Jaro, *Wenzel 475, 582, 1372.* SAMAR, Loquilocon, *Bur. Sci. 43739, 43782 McGregor.* CAMIGUIN, Mount Malabsing, *Bur. Sci. 79621 Edaño.* MINDANAO, Agusan Province, Cabadbaran (Mount Urdaneta), *Elmer 13365;* Agusan River, *Merrill 7338, Weber 1199:* Surigao Province, Placer, *Wenzel 2934, 3336, 3457:* Davao Province, Todaya, *Copeland 1453:*

Zamboanga Province, Sax River, *Merrill 8234.* DINAGAT, *Bur. Sci. 83450 Ramos and Convocar.*

*Geographical range.*—Philippine Islands.

Of the characters given by Hieronymus to distinguish *Selaginella Whitfordii,* that of the smaller leaves is the most conspicuous, but the leaves often vary considerably on the same specimen (for example, *Merrill 7338*) ; the number of steles and the roughness of the stems also vary.

### 15. SELAGINELLA NUMMULARIA Warb.

*Selaginella nummularia* WARB. in Monsunia 1 (1900) 108, 123.
*Selaginella cuernosensis* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2027.
*Selaginella maquilingensis* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2029.

LUZON, without locality, *Jagor* (type, not seen) : Isabela Province, Mount Moises, *Clemens s. n.:* Rizal Province, Angilog, *Loher 14163:* Laguna Province, Mount Maquiling, *Bur. Sci. 9741, 9753 Robinson, Merrill 629, 6304, Bur. Sci. 16872 Serviñas, Elmer 17689, 18364, Baker 284, Copeland 60, 2012:* Tayabas Province, Mount Binuang, *Bur. Sci. 28793 Ramos and Edaño.* NEGROS, Dumaguete (Cuernos Mountain), *Elmer 9651.*

*Geographical range.*—Amboina (Brooks).

The type has not been seen but van Alderwerelt van Rosenburg, in Bull. Jard. Bot. Buit. III 2 (1920) 180, refers *Elmer 17689* and *18364* to this species.

### 16. SELAGINELLA INTERTEXTA Spring. Plate 2, figs. 1–4.

*Selaginella intertexta* SPRING in Bull. Ac. Brux. 10 (1843) 233.

Philippines, without locality, *Cuming 2015.* LUZON, Ilocos Norte Province, Solsona, *Bur. Sci. 43683 McGregor:* La Union Province, Bauang, *Bur. Sci. 12972 Fenix;* San Fernando, *R. Lete 276:* Benguet Subprovince, without locality, *Bur. Sci. 5308 Ramos;* Baguio, *Williams 1260;* Sablang, *Bur. Sci. 12775 Fenix:* Pangasinan Province, Mount San Isidro, *Bur. Sci. 29937, 29949 Fenix;* Umingan, *Bur. Sci. 17782 Otanes.*

*Geographical range.*—Northern Luzon, on rocks in streams.

### 17. SELAGINELLA APOENSIS Hieron.

*Selaginella apoensis* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2028.

MINDANAO, Davao Province, Todaya (Mount Apo), *Elmer 11772.*

*Geographical range.*—Celebes (*Kjellberg 3662*).

### 18. SELAGINELLA CILIARIS (Retz.) Spring.

*Selaginella ciliaris* (Retz.) SPRING in Bull. Ac. Brux. 10 (1843) 231.
*Lycopodium ciliare* RETZ. Obs. 5 (1789) 32.
*Lycopodium Belangeri* BORY in Bel. Voy. Bot. 2 (1833) 12, *t. 1, f. 2.*
*Selaginella Belangeri* (Bory) SPRING in Mem. Ac. Belg. 24 (1850) 142.

LUZON, Benguet Subprovince, Sablang, *Bur. Sci. 12598 Fenix:* Nueva Vizcaya Province, Kiangan, *Topping 874:* Tarlac Province, Concepcion, *Merrill 3621:* Bataan Province, Lamao River, *Merrill 3775;* Mount Mariveles, *Copeland 84:* Rizal Province, Antipolo, *Bur. Sci. 16960 Ramos;* Bosoboso, *For. Bur. 3354 Ahern's collector;* Montalban, *Loher s. n.;* San Pedro Makati, *Merrill 7125. 7127;* Montalban, *Merrill 7120;* San Juan del Monte, *Merrill 673:* Manila, *Clemens s. n., Topping 644:* Batangas Province, Taal Volcano, *Merrill 10602:* Sorsogon Province, Irosin (Mount Bulusan), *Elmer 15510.* POLILLO, *Bur. Sci. 6911 Robinson.* LEYTE, Dagami, *Wenzel 435;* Palo, *Elmer 7076.* PALAWAN, San Antonio Bay, *Merrill 5253.* GUIMARAS, *Bur. Sci. 18012 Robinson.* SAMAR, Catubig River, *Bur. Sci. 24737 Edaño.* MINDANAO, Lanao Province, Camp Keithley, Lake Lanao, *Clemens 19.*

*Geographical range.*—India to southern China and northern Australia.

This is one of the most widely distributed species at low elevation; it probably endures a drier climate than most species.

### 19. SELAGINELLA BONINENSIS Baker.

*Selaginella boninensis* BAKER in Journ. Bot. 23 (1885) 178.
*Selaginella Somai* HAYATA, Ic. Pl. Formos. 7 (1918) 101, *f. 66.*

LUZON, Bataan Province, Mount Mariveles, *Merrill 3749, 7607.*

*Geographical range.*—Bonin Islands and Formosa.

### 20. SELAGINELLA OPACA Warb.

*Selaginella opaca* WARB. in Monsunia 1 (1900) 108, 122.
*Selaginella Mearnsii* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2018.
*Selaginella pervaga* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2021.
*Selaginella debilis* "Spring" ALSTON in Journ. Bot. 69 (1931) 256.

LUZON, Benguet Subprovince, Mount Tonglon, *Merrill 7730;* Baguio, *Elmer 8358, Williams 1264;* Haight's Place, *For. Bur. 4237 Mearns;* Pauai, *Bur. Sci. 8404, 8446 McGregor, Copeland s. n.;* Mount Singakalsa, *Bur. Sci. 82446 Quisumbing and Sulit:* Kalinga Subprovince, Mount Masingit, *Bur. Sci. 37586 Ramos and Edaño:* Ifugao Subprovince, Mount Polis, *Bur. Sci. 19807 McGregor:* Laguna Province, Mount Maquiling, *Loher 1318.* NEGROS, Oriental Negros Province, Dumaguete (Cuernos Mountains), *Elmer 9638;* Canlaon Volcano, *Merrill 6964.* MINDANAO, Misamis Province, Mount Malindang, *For. Bur. 4634 Mearns and Hutchinson;* Butig Mountains, *Mearns s. n.*

*Geographical range.*—Java.

The type specimen of *Selanginella debilis* (Bory) Spring is not that in Delessert Herbarium as stated in Journ. Bot. 69 (1931) 256, but a specimen in Herbarium Paris which is *Selaginella tenera* (Hk. and Gr.) Spring.

*Selaginella lanceolata* Warb., from Celebes, and *Selaginella carnea* v. A. v. R., from New Guinea, are closely allied to this species.

**21. SELAGINELLA ORNATA (Hk. and Gr.) Spring.**

*Selaginella ornata* (Hk. and Gr.) SPRING in Bull. Ac. Brux. 10 (1843) 232.
*Lycopodium ornatum* HK. and GR. in Hook. Bot. Misc. 3 (1833) 108.
*Selaginella polita* RIDLEY in Journ. Fed. Mal. States Mus. 6 (1915) 202.

LUZON, Nueva Vizcaya Province, Imugan, *Bur. Sci. 14404 McGregor.* MINDORO, Mount Halcon, *Merrill 6020, Bur. Sci. 40560 Ramos and Edaño.*

*Geographical range.*—Malay Peninsula, Indo-China, Borneo, Java, and Sumatra.

**22. SELAGINELLA LLANOSII Hieron. Plate 2, figs. 5–8.**

*Selaginella Llanosii* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2039, (*Llanoïis*).
? *Selaginella calcicola* HIERON. in Hedwigia 51 (1912) 258.

SIBUYAN, Magallanes (Mount Giting-Giting), *Elmer 12393* (type). PANAY, Capiz Province, Libucao, *Bur. Sci. 35443 Edaño and Martelino.* BILIRAN, *Bur. Sci. 18913 McGregor.* BOHOL, Dimyao, *Bur. Sci. 42995 Ramos.* MINDANAO, Zamboanga Province, San Ramon, *Copeland 1562;* Santa Maria, *Bur. Sci. 16415 Reillo.*

*Geographical range.*—Southern Philippines and perhaps Borneo.

**23. SELAGINELLA PHILIPPINA Spring. Plate 2, figs. 9–12.**

*Selaginella philippina* SPRING in Bull. Ac. Brux. 10 (1843) 140.
*Selaginella Cumingiana* PRESL, Bot. Bem. (1844) 153, nomen.
*Selaginella polyblepharis* WARB. in Monsunia 1 (1900) 110, 127.
*Selaginella Moseleyi* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2034.
*Selaginella Vidalii* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2032.
*Selaginella Hombroni* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2037.
*Selaginella philippina* var. *longiciliata* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2032.
? *Selaginella lagunensis* HIERON. ex Sasaki Cat. Govt. Herb. (1930) 50.

Philippines, without exact locality, *Cuming 1999*. LUZON, Cagayan Province, Peñablanca, *Bur. Sci. 46588 Ramos and Edaño:* Lepanto Subprovince, Cervantes, *Bur. Sci. 7051 Ramos;* Bauco, *Vanoverbergh 1751:* Ifugao Subprovince, Kiangan, *Bur. Sci. 19983, 20031 McGregor;* Banaue, *Topping 873:* Benguet Subprovince, Baguio, *Elmer 8500;* Benguet Road, *Topping 895:* Nueva Vizcaya Province, near Bayombong, *Clemens 7639:* Pangasinan Province, Mount Carysang, *Bur. Sci. 4883 Ramos:* Bataan Province, Lamao River, *Merrill 3118, For. Bur. 255 Whitford;* Mount Mariveles, *Copeland 2108, 2109, Williams 153:* Rizal Province, San Isidro, *For. Bur. 58 Foxworthy:* Laguna Province, Mount Maquiling, *Elmer 17947, Copeland s. n., Bur. Sci. 17237 Robinson, Merrill 6307, Topping 4949;* Los Baños, *Merrill 5113, Copeland 2014, Baker 285, Topping 714, 670, 671;* Mount Banahao, *Bur. Sci. 9784, 9785* Robinson; Pagsanjan, *Copeland s. n., Topping 998:* Batangas Province, Santo Tomas, *Copeland 2001;* Mount Malarayat, near Lipa, *Copeland s. n.:* Tayabas Province, Quinatacutan, *Bur. Sci. 13189 Forworthy and Ramos;* Lucban, *Elmer 9273*. MINDORO, Alag River, *Merrill 6019*. PANAY, Capiz Province, Agsaman, *Bur. Sci. 46174 Edaño:* Panay Province, Dumarao, *Merrill 6699:* Iloilo Province, *Bur. Sci. 18100 Robinson;* Tigom River, *Bur. Sci. 18044 Robinson;* Iloilo, Suague River, *Bur. Sci. 18147 Robinson*. NEGROS, Luzuriaga, *Bur. Sci. 9936 Robinson;* Dumaguete, *Elmer 10283*. LEYTE, *Wenzel 431*. SAMAR, Sinampigan, *Bur. Sci. 17636 Ramos*. MINDANAO, Davao Province, Todaya (Mount Apo), *Elmer 11722a:* Agusan Province, Bunaoan, *Weber 1201:* Zamboanga Province, Sax River, *Merrill 8226;* Sibulan River, *Copeland 975*.

*Geographical range.*—Philippines.

Hieronymus makes four species here and has left five additional manuscript names; the species certainly varies in the length and ciliation of the leaves, but I do not think that the characters are sufficiently constant for specific segregation. This species appears to have a characteristic habitat: *Whitford 255* says "on wet rocks by streams," *Copeland 2001* "wet creek-bank." The plants seem to grow closely matted together, and variations in the wetness of the habitat may account for the variability of the species.

*Selaginella polyblepharis* Warb. was collected by Wichura at "Machaichai," near Manila; I have seen a fragment in Herb. Kew, labeled "Luzon, Wichura 1931."

**24. SELAGINELLA MYOSUROIDES (Klf.) Spring.**

*Selaginella myosuroides* (Klf.) SPRING in Bull. Ac. Brux. 10 (1843) 232.
*Lycopodium myosuroides* KAULF., Enum. Fil. (1824) 19.

LUZON, Benguet Subprovince, Sablang, *Bur. Sci. 12703 Fenix:* Zambales Province, Olongapo, *For. Bur. 5825, 5827 Curran;* Anuling, *Bur. Sci. 44570 Ramos and Edaño:* Bulacan Province, near Norzagaray, *Yoder 4:* Bataan Province, Lamao Forest Reserve, *Copeland 26;* Lamao River, *Copeland 2110, Merrill 3127, 3782;* Mount Mariveles, *Copeland 2106, Williams 75, Topping 809;* Dinalupijan, *Merrill 1605:* Rizal Province, Bosoboso, *For. Bur. 3353 Ahern's collector, Bur. Sci. 16955 Ramos, 19254 Reillo, Loher 14497, 14508, Topping 1042;* Montalban, *Merrill 6239, Bur. Sci. 9541 Robinson;* San Andales, *Bur. Sci. 48850 Edaño;* Antipolo, *Topping 627;* Cueva, *Loher 1143;* Malapad na Bató, *Bur. Sci. 11842 Robinson:* Tayabas Province, Mount Binuang, *Bur. Sci. 28692 Ramos and Edaño.*

*Geographical range.*—Northern and central Luzon.

The stolons, which are very characteristic of this species, are sometimes broken off, when it resembles *Selaginella Eschscholzii* Hieron. The type was localized "insula Manilla, Chamisso."

**25. SELAGINELLA ARISTATA Spring.** Plate 2, figs. 13–16.

*Selaginella aristata* SPRING in Bull. Ac. Belg. 10 (1843) 232.
*Selaginella Pickringii* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2046.
*Lycopodium remotifolium* DESV. in Ann. Soc. Linn. Par. 6 (1827) 190.
*Selaginella myosuroides* "Spring;" BRACK., U. S. Expl. Exped. (1854) 338.
*Selaginella aristata brevifolia* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2045.
*Selaginella aristata obtusifolia* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2046.

Philippines, *Cuming 1996, Commerson,* Herb. Desvaux. LUZON, Cagayan Province, Abulug River, *Weber 1578:* Ilocos Norte Province, Bangui, *Bur. Sci. 27666 Ramos:* Benguet Subprovince, Bontoc Trail, *Clemens 7689;* Batan, *Bur. Sci. 5892 Ramos;* Sablang, *Bur. Sci. 12641, 12763 Fenix;* Mount Data, *Copeland 1911:* Bataan Province, Lamao Forest Reserve, *Copeland 25:* Rizal Province, Montalban, *Copeland s. n.:* Cavite Province, Mendez Nuñez, *Bur. Sci. 1362 Mangubat:* Laguna Province, Los Baños (Mount Maquiling), *Elmer 17963, Copeland 2015, Brackenridge 15, Topping 661, 938, Serviñas 16868, Bur. Sci. 17169 Robinson;* Pagsanjan, *Copeland 10, 1988;* Calauan, *Bur. Sci. 12413,* *12477 McGregor:* Batangas Province, Ambulong, *Marvin s. n.:* Sorsogon Province, Irosin (Mount Bulusan), *Elmer 16958.* ROMBLON, *Elmer 12171.* PANAY, Iloilo Province, Salug River, *Bur. Sci. 18102 Robinson;* Ulian, Atimonan River, *Bur. Sci. 18163 Robinson.* NEGROS, Dumaguete, *Elmer 9593, 9673.* LEYTE, Dagami, *Wenzel 433.* MINDANAO, Zamboanga, San Ramon, *Copeland 1591a, 1559, 717:* Surigao Province, Surigao, *Wenzel s. n.;* Sindangan Bay, *For. Bur. Mearns:* Agusan Province, Agusan River, *Weber 1022.*

*Geographical range.*—Reported from Java.

Copeland notes on one of his labels "bluish when fresh."

**26. SELAGINELLA ESCHSCHOLZII Hieron.**

*Selaginella Eschscholzii* HIERON. in Elm. Leaf. Phil. Bot. 6 (1913) 2041.

*Selaginella benguetensis* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2043.

*Selaginella Wormskioldii* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 2064.

LUZON, Kalinga Subprovince, Lubuagan, *Bur. Sci. 37479 Ramos and Edaño:* Bontoc Subprovince, Mount Polis, *Bur. Sci. 37709 Ramos and Edaño:* Benguet Subprovince, *Merrill 7733, 7736;* Baguio, *Elmer 8395, 14267, Copeland 1911a, Merrill 7729;* Mount Pulog, *For. Bur. 16323 Curran, Merrill, and Zschokke, Bur. Sci. 8877 McGregor, Clemens s. n., Merrill 6391;* Mount Singakalsa, *Bur. Sci. 82445 Quisumbing and Sulit;* Pauai, *Bur. Sci. 31865 Santos;* Mount Tonglon, *Topping 1207.*

*Geographical range.*—Mountains of northern Luzon.

**27. SELAGINELLA BIFORMIS A. Br.**

*Selaginella biformis* A. BR. ex Kuhn Fil. Afr. (1868) 189 nomen; Kuhn Forsch. Gazette (1889) 17, 19.

*Selaginella cupressina* SPRING in Mem. Ac. Roy. Belg. 24 (1850) 113; BRACK., U. S. Expl. Exped. (1854) 336.

*Selaginella flagellifera* BULL., Cat. (1886) 9.

*Selaginella hirticaulis* WARB. in Monsunia 1 (1900) 103, 114.

Philippines, without exact locality, *Cuming 2016.* LUZON, Apayao Subprovince, Mount Abayawan, *Bur. Sci. 14544 Ramos;* Sitio Viola, *For. Bur. 19597 Curran;* Mount Tabuan, *Bur. Sci. 77218 Ramos;* summit of Mount Caboloan, *Bur. Sci. 78737 Edaño:* Benguet Subprovince, *Merrill 7777, 7778, 7797;* Mount Tonglon, *Topping 1196;* Baguio, *Elmer 6525, Bur. Sci. 11991 Robinson, Topping 257, 332, Bur. Sci. 46491 Rivera:* Nueva Vizcaya Province, Noso, *Bur. Sci. 20069, 20077 McGregor:* Pangasinan Province, Mount San Isidro, *Bur. Sci. 29859 Fénix:* Zambales

Province, Mount Tapulao, *For. Bur. 8143 Curran and Merritt:* Pampanga Province, Mount Abu, *For. Bur. 1934 Foxworthy;* Mount Pinatubo, *Elmer 22160:* Bulacan Province, Angat, *For. Bur. 34112, 34184 Ramos and Edaño:* Bataan Province, Lamao River, *Merrill 3792, Williams 146, Meyer 2174, For. Bur. 1299 Whitford;* Mount Mariveles, *Leiberg 6156, Loher 1141;* crater of Mount Mariveles, *Copeland 2105:* Rizal Province, without locality, *For. Bur. 139 Forworthy;* Mount Canumay, *Bur. Sci. 13750 Ramos;* Mount Susong Dalaga, *Bur. Sci. 29379 Ramos and Edaño:* Laguna Province, Mount Maquiling, *Elmer 18354; Brackenridge 11; Bur. Sci. 13662 Ramos, H. F. Copeland 45;* Pagsanjan, *Copeland, Topping 996:* Batangas Province, Dacanlao, *Bur. Sci. 22404 Ramos; For. Bur. 50 Mearns:* Sorsogon Province, Irosin (Mount Bulusan), *Elmer 16854.* NEGROS, Oriental Negros Province, Canlaon Volcano, *Merrill 6937;* Dumaguete, *Elmer 9595, 9671.* MINDANAO, Zamboanga Province, San Ramon, *Copeland 1562a:* Agusan Province, Cabadbaran (Mount Urdaneta), *Elmer 13942, Weber 1198:* Bukidnon Province, Sumilao, *Bur. Sci. 15744 Fenix.*

*Geographical range.*—Indo-Malayan.

Warburg, Monsunia p. 104, gives the reference "Ges. nat. Fr. 1863" for *Selaginella biformis,* but I can find no mention of the species on page 8, which is presumably the page intended. Perhaps Bull's horticultural name should be adopted.

### 28. SELAGINELLA POLYURA Warb.

*Selaginella polyura* WARB. in Monsunia 1 (1900) 104, 116.
*Selaginella striolata* WARB. in Monsunia 1 (1900) 104, 116.
*Selaginella Merrillii* v. A. v. R. in Bull. Jard. Bot. Buit. II 1 (1911) 21.

Philippines, without exact locality, *Jagor 858* (not seen). LUZON, Apayao Subprovince, Mount Sulu, *Bur. Sci. 28420 Fenix:* Lepanto Subprovince, Bagnen, *Copeland 1911b;* Mount Masapilid, *Bur. Sci. 37882 Ramos and Edaño:* Ifugao Subprovince, Mount Polis, *Bur. Sci. 19811 McGregor:* Nueva Vizcaya Province, Caraballo Mountains, *Loher 13750; Merrill 251:* Isabela Province, Mount Moises, *Clemens 16545:* Bataan Province, Lamao River, *Merrill 3239;* Mount Mariveles, *Copeland 58:* Camarines Sur Province, Mount Isarog, *Bur. Sci. 76544 Edaño:* Pampanga Province, Mount Arayat, *Topping 496:* Rizal Province, Mount Tokduanbanoy, *Bur. Sci. 48658 Ramos and Edaño:* Albay Province, Mayon Volcano, *Bur. Sci. 75702 Ramos and Edaño.* MINDORO, Mount Halcon, *Whitehead s. n., Merrill 6015.* NEGROS, Oriental Negros Province, Mount Canlaon, *Merrill 6935;* Mount Silay, *For. Bur. 1530 Whitford;* Dumaguete (Cuernos Mountains), *Elmer 9437.* LEYTE, Jaro, *Wenzel 787, 789.* MINDANAO, Mount Dagatpan, *Warburg 14191* (not seen): Davao Province, Mount Apo, *Hachisuka s. n., Clemens 15709;* Mount Malindang, *For. Bur. 4630 Mearns and Hutchinson:* Zamboanga Province, San Ramon, *Copeland 1464a:* Bukidnon Province, Tangkulan, *Bur. Sci. 39064 Ramos and Edaño.* CAMIGUIN DE MINDANAO, *Bur. Sci. 14765 Ramos.* SULU, *Burbidge s. n.* JOLO, *Clemens 9350.*

It is difficult to separate this species from the next (of which it is probably a form) but in addition to the characters given in the key, the stems of *Selaginella polyura* are generally more slender and the terminal branchlets longer, the lateral leaves, in a dry state, curl near the apex instead of from the base, forming a broad U instead of a V; they are also more silvery beneath.

*Selaginella Merrillii* v. A. v. R. was based on *Merrill 251,* but was later reduced to *Selaginella polyura* Warb. by van Alderwerelt van Rosenburgh in Malayan Fern Allies (1915) 734.

**29. SELAGINELLA PELTATA Presl.**

*Selaginella peltata* PRESL, Bot. Bem. (1844) 152.
*Selaginella bellula* CES. in Atti R. Ac. Napoli 7 (1876) 38.
*Selaginella involvens bellula* (Ces.) HIERON. in Hedw. 50 (1910) 4.
*Selaginella microstachya* WARB. in Monsunia 1 (1900) 104, 116.
*Selaginella Warburgii* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 1988.
*Lycopodium microstachyum* DESV. ex Poir. Encycl. (1814) 554.
*Selaginella microstachya* (Desv.) HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 1988.

Philippines, without exact locality, *Cuming 1998.* LUZON, Apayao Subprovince, Mount Sulu, *Bur. Sci. 28400 Fenix;* Mount Caua, *Bur. Sci. 38054 Ramos and Edaño:* Benguet Subprovince, without locality, *For. Bur. 2835 Mearns, Merrill 7668;* Baguio, *Topping, 223, Elmer 8384;* Mount Santo Tomas, *For. Bur. 66 Mearns:* Nueva Vizcaya Province, Noso to Imugan, *Bur. Sci. 20096 McGregor:* Isabela Province, Mount Moises, *Clemens 16543:* Nueva Ecija Province, without locality, *For. Bur. 12308 Foxworthy:* Zambales Province, Mount Pinatubo, *Clemens 17336, Elmer 22329:* Pampanga Province, Mount Arayat, *Merrill 3825:* Bataan Province, Mount Mariveles, *Topping 374, 387, Copeland 2056, 2066;* Lamao River, *For. Bur. 173 Whitford, Copeland 24:* Rizal Province, Tanay, *Merrill 2311;* Bosoboso, *Bur. Sci. 1500*

*Ramos;* Mount Susong-Dalaga, *Bur. Sci. 29363 Ramos and Edaño;* Montalban, *Loher 12089, 14708:* Laguna Province, Mount Maquiling, *H. F. Copeland 60, Elmer 17744,* Siniloan Trail, *Bur. Sci. 9494 Robinson:* Tayabas Province, Atimonan, *For. Bur. 721 Whitford, Topping 1320;* Quinatacutan, *For. Bur. 13183 Foxworthy and Ramos;* Lucban, *Elmer 9272;* Binuang, *Bur. Sci. 28546 Ramos and Edaño;* Infanta, *Bur. Sci. 9388 Robinson:* Albay Province, Mayon Volcano, *Bur. Sci. 75702 Ramos and Edaño:* Sorsogon Province, Irosin (Mount Bulusan), *Elmer 16068.* MINDORO, Puerto Galera, *Kienholz 15192;* Binabay River, *Merrill 6017.* PANAY, Antique Province, Culasi, *Bur. Sci. 32336 McGregor:* Iloilo Province, *Bur. Sci. 18171 Robinson;* Jamindan, *Bur. Sci. 30852.* LEYTE, Dagami, *Wenzel 489, 492;* JARO, *Wenzel 850, 1030.* BOHOL, Bilar, *Bur. Sci. 43012 Ramos.* MINDANAO, Davao Province, Baroring Cañon, Todaya, *Copeland 1454;* Mount Apo, *Elmer 11619:* Agusan Province, Cabadbaran (Mount Urdaneta), *Elmer 13596:* Cotabato Province, Datto, *Weber:* Zamboanga Province, Malangas, *Bur. Sci. 37008 Ramos and Edaño; Merrill 8227.* JOLO, Mount Dajo, *Merrill 5323.*

*Geographical range.*—Malay Peninsula and Borneo.

### 30. SELAGINELLA MÖLLENDORFFII Hieron.

*Selaginella Möllendorffii* HIERON. in Engl. and Prantl Nat. Pfl. 1 (1901) 680; in Hedw. 41 (1902) 178.

*Selaginella subcaulescens* HAYATA, Ic. Pl. Formos. 7 (1918) 99.

*Selaginella Hayatana* KUMMERLE in Mag. Bot. Lapok 26 (1928) 100.

BATAN, Batanes Province, *Bur. Sci. 10198 McGregor, Bur. Sci. 80755 Ramos;* Santo Domingo de Basco, *Bur. Sci. 3617 Fenix.* LUZON, Cagayan Province, Pinakanawan River, Peñablanca, *Bur. Sci. 77182 Ramos:* Ilocos Norte Province, Bangui, *Bur. Sci. 43521, 43573 McGregor.*

*Geographical range.*—China, Formosa, and Indo-China.

### 31. SELAGINELLA MAGNIFICA Warb.

*Selaginella magnifica* WARB. in Monsunia 1 (1900) 103, 114, t. 3 A.

MINDANAO, Davao Province, Todaya (Mount Apo), *Elmer 11276:* Agusan Province, Cabadbaran (Mount Urdaneta), *Elmer 13364;* Agusan Valley, *Merrill 667, Weber 1203;* Mount Dagatpan, *Warburg 14199* (type not seen).

*Geographical range.*—Mindanao.

Bonaparte's *Selaginella magnifica* from Indo-China (Notes Ptérid. 14: 192) is a distinct species of *Selaginella Rolandi-Principis* Alston.

### 32. SELAGINELLA PROCERA Alston.

*Selaginella procera* ALSTON in Journ. Bot. 72 (1934) 227.

LUZON, Camarines Province, Kamagon River, *Bur. Sci. 75786 Edaño;* Kolago River, *Bur. Sci. 76525 Edaño.* CATANDUANES, Mount Mariguidon, *Bur. Sci. 30449 Ramos and Edaño.*

*Geographical range.*—Southern Luzon and Catanduanes.

### 33. SELAGINELLA ELMERI Hieron. Plate 1, figs. 1–4.

*Selaginella Elmeri* HIERON. in Fedde Repert. 10 (1911) 46.
*Selaginella Quadrasii* HIERON. in Fedde Repert. 10 (1911) 114.

CATANDUANES, Bato Trail to Viga, *Bur. Sci. 75661 Ramos and Edaño.* SAMAR, Yabong, *Bur. Sci. 17560 Ramos;* Catubig River, *Bur. Sci. 54884 Edaño;* Loquilocon, *Bur. Sci. 43739, 43743 McGregor.* LEYTE, Dagami *Wenzel 377;* Palo, *Elmer 7070* (type of *S. Elmeri*); Cabalian, *Bur. Sci. 41504 Ramos.* MINDANAO, Surigao Province, Placer, *Wenzel 3370;* without exact locality, *Quadras* (not seen); Agusan Province, Cabadbaran (Mount Urdaneta), *Elmer 13407.*

*Geographical range.*—Southern Philippines.

*Selaginella Quadrasii* Hieron. seems to be simply a large form of *Selaginella Elmeri;* there are several intermediates even in the small series of specimens enumerated here.

### 34. SELAGINELLA LATIFRONS Warb.

*Selaginella latifrons* WARB. in Monsunia 1 (1900) 106, 120.

LUZON, *Jagor* (type, fragment in Kew Herbarium): Camarines Province, Maagnas, *Bur. Sci. 6349 Robinson* (fragment in Kew Herbarium). CATANDUANES, *Bur. Sci. 30577 Ramos.*

*Geographical range.*—Southern Luzon and neighboring islands.

### 35. SELAGINELLA AGUSANENSIS Hieron.

*Selaginella agusanensis* HIERON. in Elm. Leafl. Phil. Bot. 6 (1913) 1998.

MINDANAO, Agusan Province, Cabadbaran (Mount Urdaneta), *Elmer 14194* (type).

*Geographical range.*—Confined to Mindanao.

Doubtfully distinct from the last species.

### 36. SELAGINELLA COPELANDII Hieron.

*Selaginella Copelandii* HIERON. in Fedde Repert. 10 (1911) 106.

MINDANAO, Zamboanga Province, San Ramon, *Copeland 1563* (type); Santa Maria, *Bur. Sci. 16433 Reillo:* Agusan Province, Cabadbaran, *Weber 1200;* Sax River, *Williams 2242.*

*Geographical range*.—Mindanao.

The affinity of this species is with *Selaginella latifrons*, but the median leaves are more strongly aristate.

### 37. SELAGINELLA RAMOSII Hieron.

*Selaginella Ramosii* HIERON. in Fedde Repert. 10 (1911) 52.

BATAN, Batanes Province, Mount Iraya, *Bur. Sci. 80131 Ramos*. LUZON, Tayabas Province, Malicboy, *Bur. Sci. 26916 Edaño;* Atimonan, *Merrill 3998:* Rizal Province, Tanay, *Merrill 2312;* Balacbac, *Loher 13016, 13039.*

*Geographical range*.—Northern Luzon.

Hieronymus quotes *Elmer 6152* and *Fenix 12621* for *Selaginella Ramosii* ? = *Tanay* and *Jagorii.*

### 38. SELAGINELLA NEEI Hieron.

*Selaginella Neei* HIERON. in Fedde Repert. 10 (1911) 48.

LUZON, Benguet Subprovince, Sablan, *Elmer 6152, Topping 1110:* Nueva Vizcaya Province, near Dupax, *Bur. Sci. 14269 McGregor.*

*Geographical range*.—Northern Luzon.

Hieronymus quotes *Elmer 6152* and *Fenix 12621* for *Selaginella Neei*, both from Sablan.

### 39. SELAGINELLA FÉNIXII Hieron.

*Selaginella Fénixii* HIERON. in Fedde Repert. 10 (1911) 98.

*Selaginella Gregoryi* HIERON. in Fedde Repert. 10 (1911) 102.

LUZON, Apayao Subprovince, without locality, *Bur. Sci. 13886 Ramos;* Mount Narig, Abulug River, *Weber 1536:* Isabela Province, Mount Cresta, *Bur. Sci. 77195 Ramos:* Cagayan Province, Peñablanca, *Bur. Sci. 46614 Ramos and Edaño:* Nueva Vizcaya Province, near Dupax, *Bur. Sci. 14268 McGregor:* Benguet Subprovince, Sablan, *Bur. Sci. 12702 Fénix* (type of *S. Fenixii*); between Baguio and Sablan, *Bartsch 249:* Tayabas Province, Malicboy, *Bur. Sci. 26916 Edaño:* between Malicboy and Atimonan, *Topping 1319:* Camarines Norte Province, Paracale, *Bur. Sci. 33782 Ramos and Edaño:* Sorsogon Province, Mount Bulusan, *Elmer 16091.* POLILLO, *Bur. Sci. 10300 McGregor.* ALABAT, *Bur. Sci. 48371 Ramos and Edaño.* BOHOL, *Bur. Sci. 43018 Ramos.*

*Geographical range*.—Luzon and adjacent islands.

Hieronymus quotes *Curran 9542, Gregory 145,* and *McGregor 10300* for *Selaginella Gregoryi.*

### 40. SELAGINELLA JAGORII Warb.

*Selaginella Jagorii* WARB. in Monsunia 1 (1900) 104, 116.

*Selaginella banajaoensis* HIERON. in Fedde Repert. 10 (1911) 45.

*Selaginella Meyenii* HIERON. in Fedde Repert. 10 (1911) 50.
*Selaginella sibuyanensis* HIERON. in Fedde Repert. 10 (1911) 97.
*Selaginella fallax* HIERON. in Fedde Repert. 10 (1911) 104.

LUZON, *Jagor 857* (fragment of type of *Selaginella Jagorii!* in Kew Herbarium). Manila, *Meyer* (fragment of type of *Selaginella Meyenii!* in Kew Herbarium): Bataan Province, Lamao River, Mount Mariveles, *Merrill 3241, 7609, For. Bur. 168 Whitford, Copeland 2107, Topping 364, 436, 837, Borden 2382:* Laguna Province, Los Baños (Mount Maquiling), *Copeland 12, Bur. Sci. 17034 Robinson;* Mount Banajao, *Bur. Sci. 9757 Robinson* (type of *Selaginella banajaoensis*), *Merrill 7505;* San Antonio, *Bur. Sci. 14983 Ramos:* Tayabas Province, without locality, *For. Bur. 626 Whitford;* Rio Sic Sic, Guinayangan, *Bur. Sci. 13215 Ramos:* Camarines Sur Province, Mount Potianay, *Bur. Sci. 75788 Edaño.* SIBUYAN, Magallanes (Mount Giting-Giting), *Elmer 12516* (type of *Selaginella sibuyanensis*): Sorsogon Province, Mount Bulusan, *16159 Elmer.*

*Geographical range.*—Central and southern Luzon and Sibuyan.

Hieronymus quotes *Topping 364, 436, Copeland 265, 2104, 2107, For. Bur. 168 Whitford, Merrill 3241* all from Mount Mariveles for *Selaginella fallax. Borden 2382* quoted for *Selaginella Meyenii* was also from Mount Mariveles. A plant from Mount Bulusan (Sorsogon), *Elmer 16159, 16149,* and *Bur. Sci. 23691 Ramos* with larger aristæ probably belongs to this species.

### 41. SELAGINELLA HALCONENSIS Hieron.

*Selaginella halconensis* HIERON. in Fedde Repert. 10 (1911) 108.
*Selaginella Sancti-Antonii* HIERON. in Fedde Repert. 10 (1911) 100.
*Selaginella paraguana* HIERON. in Fedde Repert. 10 (1911) 109.
*Selaginella infantensis* HIERON. in Fedde Repert. 10 (1911) 111.
*Selaginella Toppingii* HIERON. in Fedde Repert. 10 (1911) 112.

LUZON, Tayabas Province, Infanta, *Bur. Sci. 9318 Robinson:* Laguna Province, San Antonio, *Bur. Sci. 12083 Ramos* (type of *Selaginella Sancti-Antonii*); Mount Maquiling, *Topping 911* (type of *Selaginella Toppingii*). MINDORO, Mount Halcon, *Merrill 6018* (fragment of type of *Selaginella halconensis* in Kew Herbarium). PALAWAN, Iwahig River, *Merrill 755* (type of *Selaginella paraguana*); Mount Capoas, *Merrill 9549.*

### 42. SELAGINELLA AENEA Warb.

*Selaginella aenea* WARB. in Monsunia 1 (1900) 104, 115.
*Selaginella Bacanii* HIERON. in Fedde Repert. 10 (1911) 43.

LUZON, Cagayan Province, Pamplona, *Bur. Sci. 7559 Ramos* (type of *S. Bacanii*): Tayabas Province, Casiguran, *Bur. Sci. 45411 Ramos and Edaño.* MINDANAO, San Ramon, *Copeland 1591;* Mount Dagatpan, *Warburg 14192* (fragment at Kew Herbarium); Zamboanga Province, *Merrill 8216.*

*Geographical range.*—Confined to the Philippines.

*Selaginella cupressina* var. *aristulata* Hieron. should probably be placed here.

### 43. SELAGINELLA PRESLIANA Spring.

*Selaginella Presliana* SPRING in Bull. Ac. Brux. 10 (1843) 137.
*Selaginella pteryphyllos* SPRING in Mem. Acad. Belg. 24 (1850) 162.
*Lycopodium microstachyum* PRESL, Rel. Haenk. (1825) 80 non Desv.
*Selaginella myosuroides* "(Klf.)"; PRESL, Bot. Bem. (1844) 153 non *Lycopodium myosuroides* Klf.

Philippines, without exact locality, *Cuming 2017.* LUZON, *Haenke s. n.:* Cagayan Province, Mount Babatugin, *Bur. Sci. 79634 Edaño:* Isabela Province, Mount Moises, *Clemens 16545:* Tayabas Province, Mount Cadig, *Bur. Sci. 25409 Yates.*

*Geographical range.*—Northern Luzon.

### 44. SELAGINELLA LUZONENSIS Hieron.

*Selaginella luzonensis* HIERON. in Engl. and Prantl Nat. Pfl. 1 (1901) 681; in Hedwigia 41 (1902) 181.

LUZON, *Jagor 806* (fragment in Kew Herbarium!); Camarines Sur Province, Maagnas, *Bur. Sci. 6316 Robinson.* BILIRAN, *Bur. Sci. 18740 McGregor.* CATANDUANES, Mount Nagpakdit, *Bur. Sci. 75658 Ramos and Edaño.*

*Geographical range.*—Southern Luzon and adjacent islands.

### 45. SELAGINELLA FLABELLOIDES Warb.

*Selaginella flabelloides* WARB. in Monsunia 1 (1900) 105, 118.

LUZON, Isabela Province, Digamas, *Warburg 11977* (fragment in Kew Herbarium!): Tayabas Province, Guinayañgan, *Bur. Sci. 13228 Ramos.* BOHOL, Bilar, *Bur. Sci. 43018 Ramos.* PALAWAN, Mount Mantalingahan, *Bur. Sci. 77931 Edaño.* CAMIGUIN, Balatubat, *Bur. Sci. 79624 Edaño.* MINDANAO, Zamboanga Province, Sax River, *Williams 2243:* Lanao Province, Camp Keithley, Lake Lanao, *Clemens 92.*

*Geographical range.*—Confined to the Philippines.

Doubtfully distinct from *Selaginella cupressina* (Willd.) Spring.

### 46. SELAGINELLA CUPRESSINA (Willd.) Spring.

*Selaginella cupressina* (Willd.) SPRING in Flora 21 (1838) 211.
*Lycopodium cupressinum* WILLD., Sp. Pl. 5 (1810) 42.
*Lycopodium cupressiforme* "Willd.;" DESV. in Mem. Soc. Linn. Par. 6 (1827) 187 sphalm.

*Lycopodium pennula* DESV. in Mem. Soc. Linn. Par. 6 (1827) 187.
*Selaginella pennula* (Desv.) SPRING in Bull. Ac. Brux. 10 (1843) 137.
*Selaginella quadrangula* PRESL in Abh. Böhm. Ges. Wiss. 3 (1844) 581.
*Selaginella Brausei* HIERON. in Fedde Repert. 10 (1911) 41.
*Selaginella leytensis* HIERON. in Fedde Repert. 10 (1911) 42.

Philippines, without exact locality, *Cuming 2000,* in Herbarium Desvaux, *Haenke s. n.* LUZON, Cagayan Province, Claveria, *Bur. Sci. 7567 Ramos, Bur. Sci. 10737 McGregor;* Sitio Viola, *For. Bur. 19585 Curran;* Abulug River, *Weber 1537:* Apayao Subprovince, *Bur. Sci. 28167 Fénix;* Rolo, *Vanoverbergh 17734:* Isabela Province, Cordon, *Bur. Sci. 7998 Ramos:* Nueva Vizcaya Province, near Dupax, *Bur. Sci. 14265, 14267 McGregor:* Nueva Ecija Province, Caraballo Sur, *Merrill 209:* Rizal Province, Bosoboso, *For. Bur. 2689, 3422 Ahern's collector, Loher 14808;* Balacbac, *Loher 13039;* Paning-tingan, *Loher 13499;* Bosoboso, *Bur. Sci. 958 Ramos:* Laguna Province, Paete, *Bur. Sci. 22836 McGregor;* Siniloan-Infanta trail, *Bur. Sci. 22968 McGregor;* Los Baños (Mount Maquiling), *Merrill 620, Copeland s. n., Bur. Sci. 17326 Robinson and Brown, For. Bur. 26056 Mabesa, Bur. Sci. 13720 Ramos, Topping 726, 940, 496;* Pagsanjan, *Copeland 1989;* San Antonio, *Bur. Sci. 20576 Ramos:* Tayabas Province, Malicboy, *Merrill 2444;* Lucban, *Elmer 7917;* Atimonan, *Topping 1304:* Camarines Norte Province, Paracale, *Bur. Sci. 33584 Ramos and Edaño:* Camarines Sur Province, Mount Isarog, *Bur. Sci. 22040 Ramos:* Sorsogon Province, Irosin (Mount Bulusan), *Elmer 16094.* MINDORO, Puerto Galera, *Cruz s. n.;* Paluan, *Bur. Sci. 39667 Ramos.* POLILLO, *Bur. Sci. 6907 Robinson.* PALAWAN, Mount Matalingajan, *Bur. Sci. 77932.* PANAY, Capiz Province, Libucao, *Bur. Sci. 35441 Martelino and Edaño.* NEGROS, Dumaguete, *Elmer 9603.* LEYTE, *Wenzel 1175;* Dagami, *Wenzel 379;* Tacloban, *Copeland 23;* Palo, *Elmer 7058.* BOHOL, Bilar, *Bur. Sci. 43001 Ramos.* MINDANAO, Davao Province, Sibulan, *Copeland 1306, 1449;* Todaya (Mount Apo) *Elmer 11212:* Surigao Province, Surigao, *Wenzel 3372;* Placer, *Wenzel 3105, 3139, 3373:* Zamboanga Province, Bangaan, *For. Bur. 11531 Whitford:* Agusan Province, Cabadbaran (Mount Urdaneta), *Elmer 13355;* Butuan, *Weber 1197;* Malangas, *Bur. Sci. 36904 Ramos and Edaño:* Zamboanga Province, Sax River, *Williams 2243.* BASILAN, *Bur. Sci. 16196 Reillo.*

*Geographical range.*—Amboina.

Willdenow's locality Bourbon is doubtless a mistake as stated by Kuhn (Forsch. Gazette p. 18).

# ILLUSTRATIONS

## PLATE 1

FIG. 1. *Selaginella Elmeri* Hieron., habit, × 0.75.
2. *Selaginella Elmeri* Hieron., cone, × 10.
3. *Selaginella Elmeri* Hieron., leaves from above, × 10.
4. *Selaginella Elmeri* Hieron., leaves from beneath, × 10.

## PLATE 2

FIG. 1. *Selaginella intertexta* Spring, habit, × 1.
2. *Selaginella intertexta* Spring, cone from beneath, × 10.
3. *Selaginella intertexta* Spring, leaves from above, × 10.
4. *Selaginella intertexta* Spring, leaves from below, × 10.
5. *Selaginella Llanosii* Hieron., habit, × 1.
6. *Selaginella Llanosii* Hieron., cone from beneath, × 10.
7. *Selaginella Llanosii* Hieron., leaves from beneath, × 10.
8. *Selaginella Llanosii* Hieron., leaves from above, × 10.
9. *Selaginella philippina* Spring, habit, × 1.
10. *Selaginella philippina* Spring, cone from beneath, × 10.
11. *Selaginella philippina* Spring, leaves from above, × 10.
12. *Selaginella philippina* Spring, leaves from beneath, × 10.
13. *Selaginella aristata* Spring, cone from beneath, × 10.
14. *Selaginella aristata* Spring, leaves from beneath, × 10.
15. *Selaginella aristata* Spring, leaves from above, × 10.
16. *Selaginella aristata* Spring, habit, × 10.

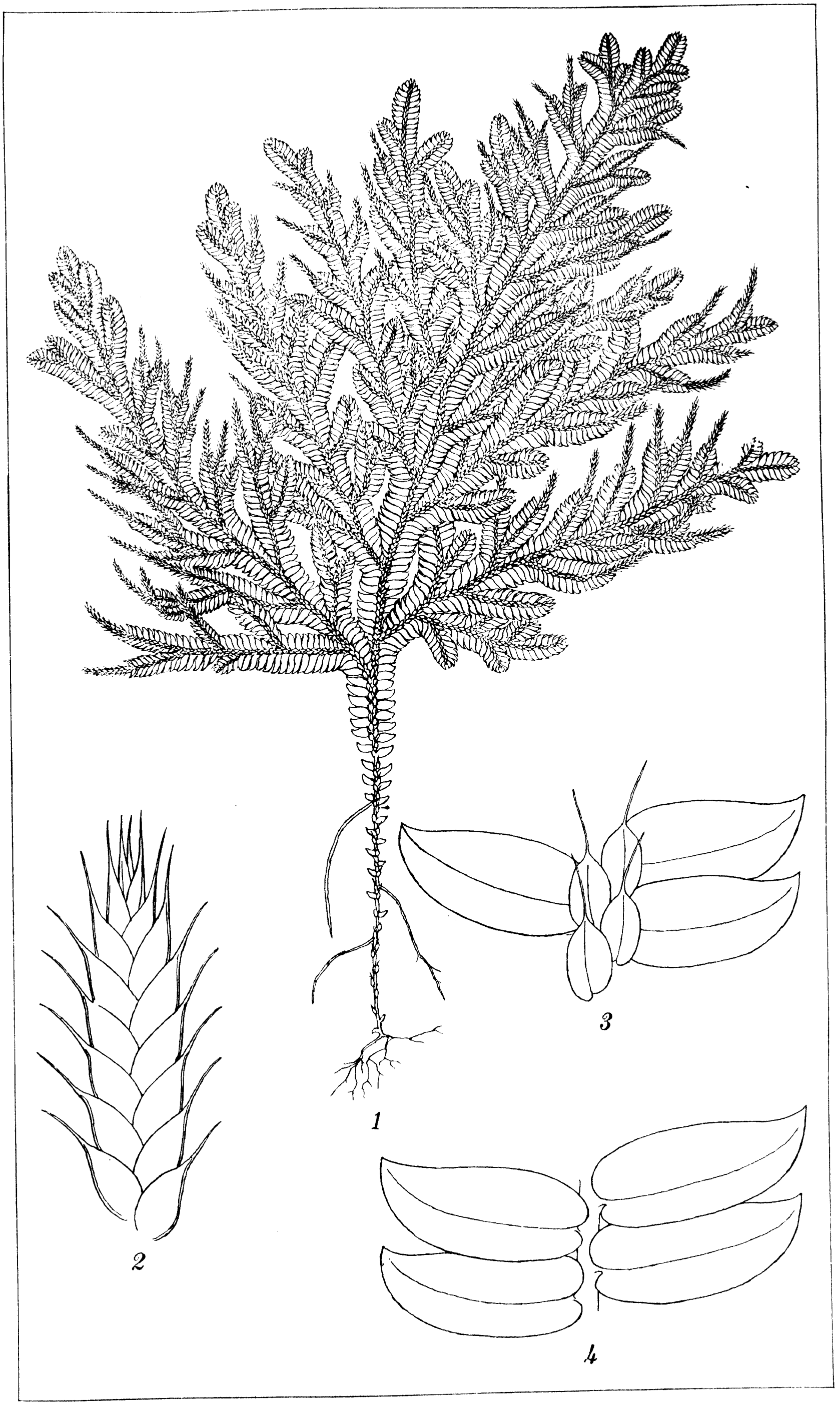

PLATE 1.

UNIV. OF MICH.

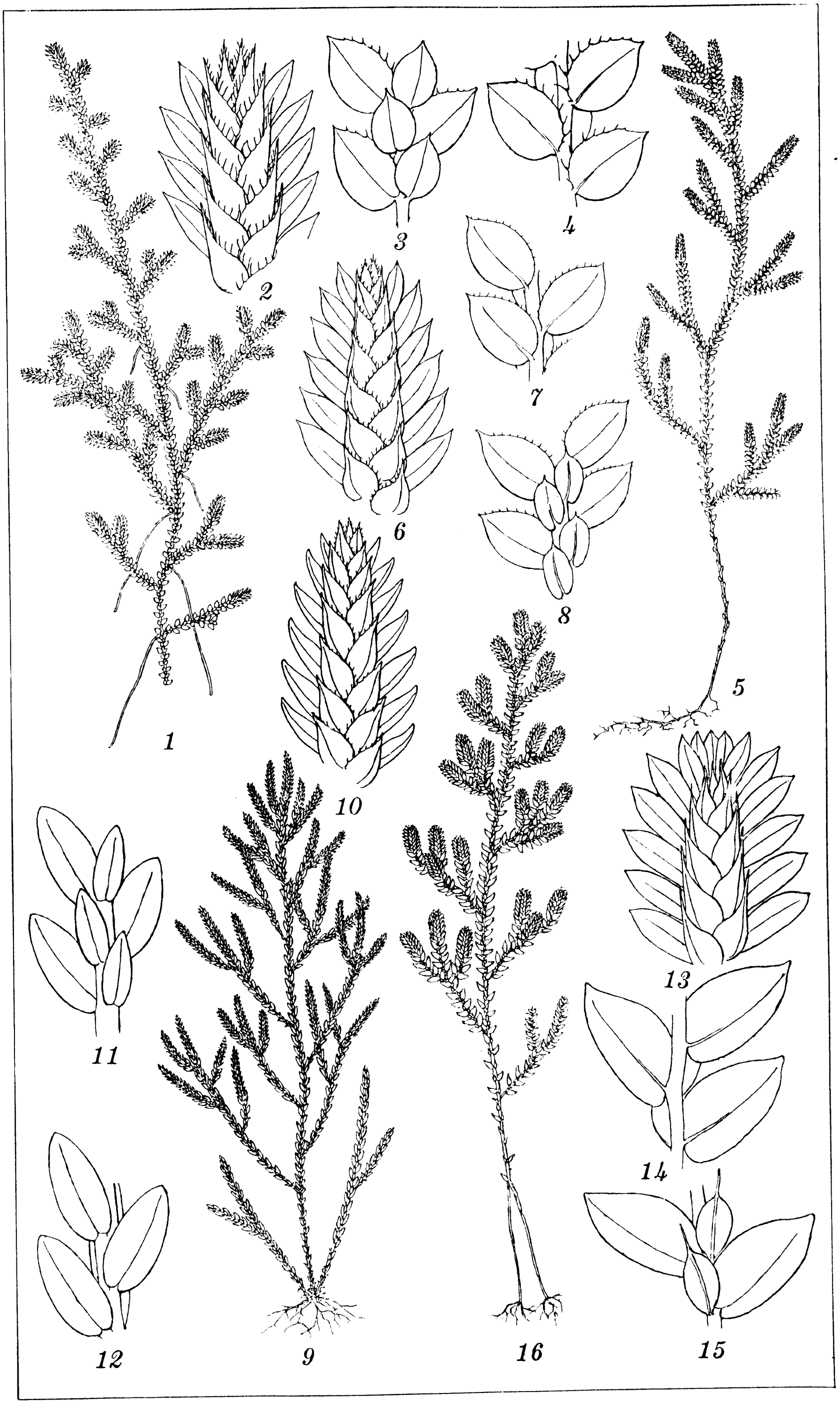

PLATE 2.

# NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXVIII[1]

By CHARLES P. ALEXANDER
*Of Amherst, Massachusetts*

FOUR PLATES

The new species discussed in the present report are chiefly from Kashmir, where they were collected by Miss Vivien R. Hutchinson. A few additional species are from Celebes, collected by Clagg; Java, by Handschin and Walsh; Japan, by Issiki; and China, by Franck, Graham, and Suenson. Except where stated to the contrary in the text, the types of the novelties are preserved in my collection of these flies. I wish to express my deepest appreciation to all of the above-mentioned entomologists, who have aided materially in the progress of this study of the Asiatic Tipulidæ. In order to complete the data, I have included in this paper the descriptions of a few species of the allied family Trichoceridæ, commonly called the winter crane flies.

## TRICHOCERIDÆ

### TRICHOCERA ALTICOLA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

Size very large (wing, female, over 10 millimeters); general coloration uniformly dark gray to blackish gray; antennæ with basal six or seven flagellar segments incrassated, the outer segments suddenly narrowed; knobs of halteres darkened; legs brownish black; wings clear, highly iridescent; stigma conspicuous, elongate, brown, extending the entire length of vein $R_{1+2}$; $R_{2+3+4}$ shorter than $R_{2+3}$; $R_{1+2}$ elongate; abdomen uniformly dark brown; cerci with the lower or ventral edge gently emarginate.

*Female.*—Length, about 9 millimeters; wing, 10.4 by 3.3.

Rostrum gray; palpi black. Antennæ black throughout; basal segment of flagellum long-conical; succeeding five or six segments slightly incrassated, the remainder very slender and somewhat paler than the basal ones. Head dark gray.

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[1] Contribution from the entomological laboratory, Massachusetts State College.

Mesonotum uniformly dark gray to blackish gray, without markings. Pleura dark gray. Halteres pale, the knobs infuscated. Legs with the coxæ and trochanters blackish gray; remainder of legs brownish black. Wings (Plate 1, fig. 1) clear, highly iridescent, with a conspicuous, elongate, brown stigmal area extending the entire length of vein $R_{1+2}$; indications of a much smaller seam on r-m; veins dark brown, the basal third of vein M paler. Macrotrichia of veins short and inconspicuous but well distributed on almost all veins. Venation: $R_{2+3+4}$ shorter than $R_{2+3}$; $R_{1+2}$ elongate, approximately one-half the length of Rs; cell $M_1$ nearly twice its petiole; m-cu at fork of $M_{3+4}$.

Abdomen uniformly dark brown, only the pleural membrane pale. Cerci (Plate 2, fig. 25, *c*) with the lower or ventral edge gently emarginate, not straight as in *simonyi.*

*Habitat.*—Kashmir.

Holotype, female, Bitzal Nullah, West Karakoram, altitude 14,000 feet, September 2, 1934 (*Hutchinson*).

The only other generally similar species is *Trichocera simonyi* Mik,[2] described from the Tyrolian Alps, at high altitudes (9,350 feet), collected in early October. Apparently this latter species is still known only from the unique female types. The present fly is almost exactly like *simonyi* in size and further agrees in the general features of coloration, but differs evidently in the conspicuous brown stigma of the wings and the distinct structure of the cerci of the ovipositor.

**TRICHOCERA GLACIALIS** sp. nov. Plate 1, fig. 2; Plate 2, fig. 26.

General coloration dull black, sparsely pruinose; wings subhyaline, with a sparse pale gray pattern, including seams at r-m and beneath the origin of Rs, additional to restricted markings elsewhere; $R_{2+3+4}$ about one-half $R_{2+3}$; cell $M_1$ a little longer than its petiole; abdomen distinctly annulated, the tergites pale brown with the caudal borders narrowly dark brown; sternites yellow, the margins narrowly pale; ventromesal lobe of basistyle at apex produced caudad into a slender dusky lobule.

*Male.*—Length, about 6.5 millimeters; wing, 7.5.

Rostrum brownish gray; palpi black. Antennæ with the scape and pedicel brownish black, the flagellum somewhat darker; flagellar segments beyond the first moderately incrassated, the

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[2] Wien. Ent. Zeitung 5 (1886) 5–59.

succeeding segments gradually more slender. Head blackish gray.

Pronotum brownish black, the posterior notum obscure yellow. Mesonotum dull black, sparsely pruinose, without evident markings. Pleura dark brown, the dorsopleural region somewhat paler. Halteres relatively long, pale, the knobs infuscated. Legs with the coxæ pale, more darkened basally; tibiæ and tarsi dark brown. Wings (Plate 1, fig. 2) subhyaline, with a sparse pale gray pattern, including a seam at r-m; on one wing of type with a second area, scarcely separated from the first, lying in outer end of cell R; a large cloud beneath origin of Rs; narrow seams along m-cu and outer end of cell 1st $M_2$; very small and insignificant clouds at fork of $M_{1+2}$ and at near two-thirds the length of cell $R_4$; vague indications of a cloud at tip of vein 2d A; stigmal area not darkened; veins brown. Macrotrichia of veins short but abundant. Venation: $R_{2+3+4}$ unusually short, somewhat less than one-half $R_{2+3}$, the latter a little shorter than subequal to $R_{1+2}$; basal section of $R_5$ slightly reduced; cell $M_1$ a little longer than its petiole; m-cu shortly before fork of $M_{3+4}$; cell 2d A narrow.

Abdomen distinctly annulated, the tergites pale brown with their caudal margins narrowly dark brown; sternites light yellow, beyond the first segment with the caudal borders narrowly and weakly darkened; subterminal segments more uniformly darkened; hypopygium a little brightened. Male hypopygium (Plate 2, fig. 26) with the ventromesal lobe of basistyle, *b*, unusually stout, the apex truncated and with the outer apical angle further produced caudad into a slender dusky lobule; the lobes of the two sides touch and thus form a contiguous bridge. Dististyle, *d*, distinctly narrowed on a little more than the distal third, gently curved, without a distinctly developed lobule on mesal face. Gonapophyses very long and slender, gradually narrowed to needlelike points.

*Habitat.*—Kashmir.

Holotype, male, Kerolungma Glacier, Baltistan, altitude 11,000 feet, August 26, 1934 (*Hutchinson*).

By keys to the Holarctic species of *Trichocera*, the present fly runs to *T. annulata* Meigen, from which it differs in the patterned wings and structure of the male hypopygium. On the basis of wing pattern, the fly runs to *T. maculipennis* Meigen, differing conspicuously in the coloration of the body and wings, and in the structure of the hypopygium, notably the peculiar apical lobule of the basistyles (coxites).

**TRICHOCERA ABIETICOLA** sp. nov. Plate 1, fig. 3; Plate 2, fig. 27.

General coloration dark brownish gray; legs dark brown, the femoral bases restrictedly obscure yellow; wings with a pale brown tinge, sparsely patterned with pale gray clouds, including areas on anterior cord and beneath origin of Rs; veins $R_{2+3+4}$ and $R_{2+3}$ both relatively long and subequal in length; abdominal tergites dark brown; ventromesal lobe of basistyle contiguous at midline with its mate of the opposite side, its apex obtusely rounded; dististyle subcylindrical, unarmed.

*Male.*—Length, about 6.5 millimeters; wing, 7.2 to 7.3.

Rostrum dark brown; palpi black. Antennæ black throughout. Head brownish gray.

Mesonotum almost uniformly dark brownish gray, without markings. Pleura dark gray, the dorsopleural region brown. Halteres dusky, the extreme base of stem pale. Legs with the coxæ brownish gray; trochanters pale brown; remainder of legs dark brown, the femoral bases restrictedly obscure yellow. Wings (Plate 1, fig. 3) with a very pale brownish tinge, sparsely patterned with pale gray clouds, including areas on anterior cord, beneath origin of Rs, outer end of cell 1st $M_2$, fork of $M_{1+2}$ and at near two-thirds the length of vein $M_4$; stigmal region vaguely washed with pale brown; veins dark brown. Macrotrichia of veins relatively short. Venation: $R_{2+3+4}$ and $R_{2+3}$ subequal and relatively long, each being nearly one-third as long as Rs; $R_{2+3}$ longitudinal in position, not subperpendicular as in some allied species; m-cu shortly before fork of $M_{3+4}$.

Abdominal tergites dark brown throughout, the basal sternites somewhat paler. Male hypopygium (Plate 2, fig. 27) with the ventromesal lobe of basistyle, *b*, relatively slender, contiguous at midline with its mate of the opposite side to form a bridge, at apex gently rounded. Dististyle, *d*, slender, subcylindrical, or very slightly narrowed outwardly, unarmed at base.

*Habitat.*—Kashmir.

Holotype, male, Bandapur, altitude 9,000 feet, caught beneath young silver-fir trees, November, 1934 (*Hutchinson*). Paratopotypes, 1 male with type; 1 male, altitude 7,000 feet, November 15, 1934.

The nearest ally of the present species would appear to be *Trichocera glacialis* sp. nov., rather than other somewhat similar forms that are allied to *maculipennis*. Both of these Kashmir species have the same pale gray wing pattern and uniformly darkened legs, but the present fly is readily told by the venation of the radial field, the unarmed ventromesal lobe of the basistyle, and the uniformly darkened abdomen. *Trichocera punctipennis* Brunetti and some allied forms are very different in their leg pattern, having a narrow but distinct subterminal brown ring on femora, additional to other differences of venation, wing pattern, and structure of the male hypopygium.

## TIPULIDÆ

### TIPULINÆ

**CTENACROSCELIS NIMBUS** sp. nov. Plate 1, fig. 4; Plate 2, fig. 28.

Belongs to the *brobdignagius* group; mesonotal præscutum dark brown, with four more grayish brown stripes; posterior border of scutum and scutellum entirely black; mediotergite uniformly gray; pleura yellow, with a dorsal brown stripe; wings strongly tinged with brown, variegated by clearer areas in cells M, Cu, 1st A, and 2d A; abdomen dark brownish gray; hypopygium dark; male hypopygium with the outer dististyle broad, only slightly narrowed outwardly; eighth sternite with a large brush of yellow setæ on each lateral lobe.

*Male.*—Length, excluding head, about 25 millimeters; wing, 36.5.

Head broken.

Pronotum chiefly light yellow, restrictedly darkened on ventral portion and on propleura. Mesonotal præscutum with the ground color dark brown, with four more grayish brown stripes, the midline broad, more than one-half as wide as either of the intermediate stripes; ground color and stripes becoming less evident and differentiated behind; lateral borders of præscutum broadly light yellow; scutum brownish gray, including the median area, the posterior border and scutellum entirely black; parascutella on posterior half more yellow; mediotergite uniformly gray. Pleura yellow, with a relatively narrow dorsal brown stripe; ventral sternopleurite very weakly darkened. Halteres dusky. Legs with the coxæ and trochanters yellow; femora yellow, the tips rather narrowly but very conspicuously blackened; tibiæ yellow, the tips narrowly and inconspicuously infuscated; tarsi passing through yellow to black. Wings (Plate 1, fig. 4) strongly tinged with brown, variegated by clearer areas across bases of anal cells and near central portion of cell Cu; a conspicuous pale area in outer end of cell M; prearcular region more blackened; stigma and costal region more saturated yellow; restricted obliterative areas along cord; a narrow dark brown seam along m-cu; veins yellowish brown. Venation: $R_1$ shortly before fork of $R_{2+3}$, obliterating $R_2$; vein $R_3$ somewhat angularly bent at near two-thirds the length; m-cu shortly before fork of $M_{3+4}$.

Abdomen dark brownish gray; hypopygium dark. Male hypopygium with the ninth tergite (Plate 2, fig. 28, *9t*) elongate, the caudal margin with a deep U-shaped notch, the lateral lobes subtruncate; abundant setæ on outer two-fifths of tergite, these longer and more numerous on lateral border cephalad of the lobes, the latter with relatively short setæ only. Outer dististyle, *od*, unusually broad, nearly parallel-sided, so the apex is very broad and rounded; distal third of style without setæ; basal setæ more elongate. Inner dististyle, *id*, enlarged at outer end. Eighth sternite, *8s*, relatively long, the caudal margin deeply notched but with the emargination chiefly filled with pale membrane; lateral lobes obliquely truncated, tufted with dense brushes of long yellow setæ; ventral surface of lobes with abundant smaller setæ, narrowly lacking on the midline behind base of the emargination.

*Habitat.*—China (Szechwan-Tibet border).

Holotype, male, Mupin, altitude 3,500 feet, June, 1929 (*Graham*); type in the United States National Museum collection.

The present species is most nearly allied to *Ctenacroscelis libertus* Alexander, differing in the coloration of the mesonotum and wings, and in the structure of the male hypopygium, especially of the styli and the eighth sternite.

**TIPULA (SINOTIPULA) HUTCHINSONÆ sp. nov.** Plate 1, fig. 5; Plate 2, figs. 29, 30.

Allied to *griseipennis;* frontal prolongation of head elongate, nasus lacking; antennal flagellum almost uniformly brownish black; head gray, with a median brown area; mesonotal præscutum gray, with three darker gray stripes that are narrowly bordered by dark brown; legs yellow, the tips of femora, tibiæ, and basitarsi narrowly darkened; wings whitish subhyaline, with a pale gray and grayish brown tesselated pattern; abdomen (male) chiefly yellow, the basal tergite gray, the terminal two segments black; in female, abdominal tergites broadly darkened laterally; male hypopygium with the median tergal lobe very low and obtuse, set with microscopic black spines and spinous setæ; a single complex bilobed dististyle; eighth sternite unarmed.

*Male.*—Length, about 18 millimeters; wing, 20.5.

*Female.*—Length, about 23 to 24 millimeters; wing, 27.

Frontal prolongation of head long and slender, entirely without nasus, brownish black; palpi black, relatively short. Antennæ with scape and pedicel yellow; flagellum almost uniformly brownish black, the basal enlargements of the segments only a trifle darker than the remainder; flagellar segments very feebly incised; verticils shorter than the segments. Head gray, the central portion of the postfrons and vertex occupied by a conspicuous dark brown area; vertical tubercle low and indistinct.

Mesonotal præscutum light gray, with three darker gray stripes, the broad median stripe narrowly bordered on outer margins by dark brown and further split by a very indistinct, paler gray, median vitta; lateral stripes with a dark brown spot at cephalic-lateral portion; female with lateral stripes entirely bordered by dark brown; scutal lobes gray, each variegated by two brown areas, the more anterior smaller and darker; scutellum and mediotergite gray, the latter with indications of a darker median vitta. Pleura dark gray, the dorsopleural membrane infuscated; a few short setæ on propleura. Halteres obscure yellow, the bases of knobs infuscated. Legs with the coxæ gray; trochanters pale, their apices darkened; femora yellow, the tips narrowly but conspicuously blackened; tibiæ and basitarsi obscure yellow, clearer basally, the tips narrowly brownish black; remainder of tarsi brownish black. Wings (Plate 1, fig. 5) whitish subhyaline, with a pale gray and grayish brown tesselated pattern, distributed about as in other members of the subgenus; stigma and a confluent area on anterior cord, together with a small spot at origin of Rs, darker; cells C and Sc uniformly pale; small spots of the ground color in outer ends of cells $R_3$ to 2d A, inclusive, becoming larger in the posterior cells; veins brownish yellow to pale brown. Venation: $R_{1+2}$ entire; Rs from one-third to one-half longer than m-cu.

Abdomen (male) obscure yellow, the basal segment gray, the succeeding segments more grayish laterally; sternites narrowly darkened on sides; outer two segments uniformly brownish black. In female, abdomen with basal tergite gray, succeeding segments chiefly dark brown, bordered laterally and caudally by grayish, the median region of tergites broadly yellow. Male hypopygium (Plate 2, fig. 29) with the suture between the tergite, 9*t*, and sternite, 9*s*, feebly indicated; ninth sternite deeply emarginate, the edges of the incision with abundant short erect brown setæ. Ninth tergite (Plate 2, fig. 30, 9*t*) short and compact, the median area decurved into a low obtuse lobe set with short dense black spines and spinous setæ. A single complex dististyle, about as illustrated (Plate 2, fig. 30, *d*). Eighth sternite unarmed.

*Habitat.*—Kashmir.

Holotype, male, Baltistan, altitude 14,000 feet, July 18, 1934, resting under rocks on stony hillside (*Hutchinson*).

Allotopotype, female. Paratype, female, Deosai, Shingo Valley, altitude 11,800 feet, July 24, 1934 (*Hutchinson*).

I take great pleasure in naming this striking fly in honor of the collector, Miss Vivien R. Hutchinson, who has added materially to our hitherto scanty knowledge of the Tipulidæ of Kashmir. The fly is most nearly related to *Tipula* (*Sinotipula*) *griseipennis* Brunetti, which differs evidently in the bicolorous antennæ and in the structure of the male hypopygium, as the apex of the tergal lobe.[3]

### TIPULA (ACUTIPULA) IRREQUIETA sp. nov. Plate 1, fig. 6; Plate 2, fig. 31.

General coloration gray, præscutal stripes not or scarcely indicated; antennæ yellow; wings with cells of outer radial field whitish, the remaining cells pale yellowish brown to gray; abdominal tergites brownish gray, the sublateral borders darker brown; male hypopygium with the tergite and sternite separated by a weak suture; median lobe of tergite very low and depressed, with a small notch, producing two broad obtuse lobules set with blackened spines.

*Male.*—Length, about 19 millimeters; wing, 18.

Frontal prolongation of head light brown; nasus distinct; palpi chiefly pale. Antennæ yellow, the bases of the flagellar segments not or scarcely darkened; verticils considerably longer than the segments. Head brown, the front and anterior vertex more silvery gray.

Pronotum yellowish gray. Mesonotum gray, the præscutal stripes not or scarcely indicated; humeral region restrictedly pale yellow; lateral portions of mediotergite narrowly pale. Pleura yellowish gray, the dorsal pleurotergite somewhat darker. Halteres dusky, the base of stem scarcely paler. Legs with the coxæ and trochanters yellow; femora and tibiæ yellowish brown, the tips narrowly and weakly darkened; tarsi pale brown, passing into darker. Wings (Plate 1, fig. 6) narrow, conspicuously bicolorous; ground color of cells before cord and outer medial field pale yellowish brown to gray, the outer radial field and cell 1st $M_2$ abruptly whitish, this latter color likewise involving restricted portions of cells $R_1$, R, and M, and narrow bases of $M_1$, 2d $M_2$, and $M_3$, cells C and Sc infumed but much paler than the brown stigma; a conspicuous dark cloud in outer end of cell M; veins brown. Macrotrichia of veins beyond cord virtually lacking. Venation: $R_{1+2}$ elongate, nearly straight, subequal to Rs or $R_{4+5}$; petiole of cell $M_1$ shorter than r-m.

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[3] Edwards, Rec. Indian Mus. 26 (1924) 305; Ann. & Mag. Nat. Hist. X 1 (1928) 687.

Abdominal tergites brownish gray, the sublateral borders rather broadly darker brown, the extreme lateral margins gray; sternites a little paler, bordered with dusky. Male hypopygium with the tergite and sternite separated by a weak suture; basistyle separated by a ventral suture only. Ninth tergite (Plate 2, fig. 31, 9*t*) with the median lobe very low and depressed, with a small notch that produces two broad obtuse lobules that are set with blackened spines. Outer dististyle, *od,* very broad, pale. Inner dististyle, *id,* complex, as figured.

*Habitat.*—Kashmir.

Holotype, male, Skarda, Baltistan, altitude 7,000 feet, September 10, 1934, at light in tent (*Hutchinson*).

*Tipula* (*Acutipula*) *irrequieta* is very different from all other described species of the subgenus, differing especially in the peculiar nature of the wing pattern and in the structure of the male hypopygium. The suture between the tergite and the sternite of the latter is more distinct than in most other species of the subgenus. The present fly shows several points of resemblance to the typical subgenus *Tipula,* especially to members of the *oleracea* group, but from the structure of the hypopygium and the nature of the trichiation of the wing veins I prefer to place it in *Acutipula,* at least until more material becomes available.

### TIPULA (OREOMYZA) BALTISTANICA sp. nov. Plate 1, fig. 7; Plate 2, figs. 32, 33.

Belongs to the *variipennis* group; nasus distinct; general coloration gray, the præscutum with four entire brown stripes; femora yellow, the tips narrowly but conspicuously blackened; claws (male) simple; wings cream-colored, variegated by abundant zigzag pale gray clouds; basal section of $R_{4+5}$ reduced, abdominal tergites orange-yellow, with a broad, brownish black, lateral stripe; eighth and ninth sternites blackened; male hypopygium with the eighth sternite transverse or weakly convex across margin, set with abundant spinous setæ.

*Male.*—Length, 11 to 12 millimeters; wing, 12 to 13.5.

Frontal prolongation of head gray, relatively long; nasus distinct, tufted with long yellow setæ; palpi black. Antennæ (male) moderately long, if bent backward extending about to root of halteres; scape and pedicel brownish yellow, flagellum black; flagellar segments moderately incised, with verticils that are shorter than the segments. Head gray, the orbits a trifler clearer gray.

Mesonotal præscutum light gray, with four entire brown stripes, the anterior ends of the intermediate pair obsolescent; pseudosutural foveæ black, subcircular; scutal lobes gray, each with two separate brown areas; scutellum and mediotergite gray, the parascutella more yellow. Pleura gray; dorsopleural membrane yellow. Halteres obscure yellow, the knobs infuscated. Legs with the coxæ gray; trochanters brownish yellow; femora yellow, the tips narrowly but conspicuously blackened, the amount subequal on all legs; tibiæ brownish yellow, becoming more obscure outwardly, the tips blackened; tarsi brownish black; claws (male) simple. Wings (Plate 1, fig. 7) with the ground cream-colored, variegated by tesselated pale gray clouds; cell Sc and the stigma uniformly brown; the zigzag cream and gray areas include all cells; the posterior prearcular region and bases of anal cells pale; veins dark. Venation: Basal section of $R_{4+5}$ reduced; veins inclosing cells $M_1$ and 1st $M_2$ arcuated, as in the group.

Abdominal tergites orange-yellow, with a broad, brownish black, lateral stripe that is narrowly interrupted at the posterior portion of the segments; sternites similar, the eighth and ninth sternites blackened. Male hypopygium (Plate 2, fig. 32) small; tergite, 9*t*, and sternite separate; ventral suture short. Ninth tergite (Plate 2, fig. 32, 9*t*) with a broad rounded emargination on posterior border, the lateral lobes decurved into blackened points that are more or less bifid at tips. Basistyle, *b*, at proximal ends of dististyles with an obtuse blackened lobe on mesal aspect. Both dististyles (Plate 2, fig. 33, *id, od*) small and simple, dark-colored; outer style flattened, the margin at base narrowly blackened and microscopically roughened. Eighth sternite, 8*s*, with apex transverse or weakly convex, set with abundant spinous setæ.

*Habitat.*—Kashmir.

Holotype, male, Baltistan, altitude 11,800 feet, July 2, 1934 (*Hutchinson*). Paratopotypes, 6 males, July 2 to 4, 1934; paratype, 1 male, Deosai, Shingo Valley, July 23, 1934 (*Hutchinson*).

The venation and the type of hypopygium of the present fly are much as in members of the *marmorata* group, but the claws of the male are simple and I am referring the species to the *variipennis* group. The fly bears a superficial resemblance to *Tipula* (*Oreomyza*) *tetragramma* Edwards (Yunnan), but is amply distinct.

**TIPULA (OREOMYZA) VENERABILIS sp. nov.** Plate 1, fig. 8; Plate 3, fig. 34.

General coloration brownish gray, the præscutum with four narrow brown stripes; antennæ (male) relatively long, if bent backward extending about to base of abdomen; legs black, the femoral bases brightened; claws simple; wings narrow, obscure yellow, the prearcular field orange-yellow; a sparse clouded brown pattern, including an area in center of outer radial field; m-cu close to fork of M; abdomen brownish yellow, the lateral portions of the tergites darkened; male hypopygium with the ninth tergite notched, the margins set with blackened spines; eighth sternite with caudal margin convexly rounded, without lobes.

*Male.*—Length, 10 to 13 millimeters; wing, 11 to 14.

Frontal prolongation of head brownish black, gray pruinose; nasus long and slender; palpi black. Antennæ with scape and pedicel yellow; flagellum black; antennæ moderately elongate, in male, if bent backward extending about to base of abdomen; flagellar segments feebly incised; verticils shorter than the segments; terminal segment globular. Head brownish gray, somewhat darker behind.

Mesonotal præscutum brownish gray, clearer gray on lateral and humeral portions; four narrow dark brown stripes, the anterior ends of the intermediate pair invaded by gray; pseudosutural foveæ reduced to tiny black spots; scutum gray, each lobe with two brown areas; posterior sclerites of notum gray. Mesonotum small and relatively low. Pleura gray; dorsopleural region brownish yellow. Halteres brown, the knobs darker. Legs with the coxæ gray; trochanters brownish yellow; femora black, the bases restrictedly obscure yellow; tibiæ and tarsi black; claws simple. Wings (Plate 1, fig. 8) narrow; ground color obscure yellow, the prearcular field orange-yellow; stigma brown;

a conspicuous brown cloud in outer radial field, involving cells $R_2$ and $R_3$ but not reaching apices of cells, more extensive in some specimens than in others but apparent in all individuals; cell C pale brownish yellow, Sc clearer yellow; a pale brown cloud on anterior cord; weak gray washes in outer ends of cells Cu, 1st A, and 2d A; veins brown, the prearcular veins and basal third of M yellow. Venation: $Sc_1$ indicated by a spur; $R_{1+2}$ preserved; Rs elongate, with strong trichia; cell 1st $M_2$ narrow, parallel-sided; petiole of cell $M_1$ subequal to or exceeding m; $M_{3+4}$ very short to virtually lacking; m-cu on $M_4$ just beyond origin and thus close to fork of M.

Abdomen brownish yellow, the lateral portions of the tergites narrowly gray, the sublateral portions of both tergites and sternites weakly infuscated, becoming somewhat more extensive on outer segments; basal tergite gray; subterminal sternites brownish gray; hypopygium pale. The paratype from Deosai has the abdomen uniformly dark gray, the caudal and lateral borders of the segments narrowly yellow. Male hypopygium (Plate 3, fig. 34) small and simple; suture between tergite, *9t*, and sternite indicated; suture between basistyle, *b*, and sternite long and straight. Ninth tergite, *9t*, extensive, broader than long, the caudal margin with a very broad V-shaped emargination, at base of which is a small U-shaped notch; apical margin of lobes set with small blackened spines; a group of from fifteen to twenty black setæ surrounding the median notch; on ventral surface near lateral border with a small curved appendage on either side. Basistyle, *b*, with a blackened obtuse lobe on mesal aspect at base of dististyles. Both dististyles, *id, od,* simple, the outer with posterior margin on basal half narrowly blackened. Eighth sternite, *8s*, with apex convexly rounded, with a few strong, erect, black setæ at this point.

*Habitat.*—Kashmir.

Holotype, male, Upper Pulwar Nullah, altitude 11,000 feet, October 2, 1934 (*Hutchinson*). Paratopotypes, 20 males; paratype, male, Deosai, altitude 13,000 feet, September 13, 1934 (*Hutchinson*).

I refer the species to *Oreomyza* with some slight doubt. The general appearance is more as in some members of the typical subgenus, as the *luteipennis* group, but the present insect seems to be more nearly related to *variipennis* and allies. The peculiar wing pattern is distinctive.

**TIPULA (OREOMYZA) ICARUS** sp. nov. Plate 1, fig. 9; Plate 3, figs. 35, 36.

Sexes strongly dimorphic, the males fully winged, the females subapterous; mesonotal præscutum light gray with two intermediate more brownish stripes that are a little bowed at midlength; fore femora chiefly blackened, the remaining femora reddish brown with the tips narrowly blackened; wings (male) almost uniformly grayish yellow, the stigma pale yellowish brown; abdominal tergites dark gray, narrowly margined caudally and laterally with yellow; male hypopygium with lateral lobes of tergite of unusual length.

*Male.*—Length, 10 to 12 millimeters; wing, 12 to 15.

*Female.*—Length, about 13 to 14 millimeters; wing, 2.8 to 3.

*Male.*—Frontal prolongation of head of moderate length, dark gray; nasus short and stubby, with long yellow setæ. Antennæ of moderate length; scape and pedicel brownish black, flagellum black throughout; flagellar segments not or scarcely incised; verticils subequal to or shorter than the segments. Head gray; anterior vertex broad.

Mesonotal præscutum light gray, with two, intermediate, more brownish stripes that are a little bowed at midlength, inclosing a slightly darker gray median vitta; lateral stripes obsolete; scutal lobes weakly darkened; posterior sclerites of notum gray. Pleura gray; dorsopleural membrane buffy. Halteres brown, the base of stem yellow, the knob dark brown. Legs with the coxæ gray; trochanters obscure yellow; fore femora chiefly blackened, the bases narrowly pale; middle and posterior femora more reddish brown, the tips narrowly blackened; tibiæ brown, the tips narrowly darkened; tarsi black; tibial spur formula 1–2–2; claws simple. Wings (Plate 1, fig. 9) broad, almost uniformly grayish yellow; stigma pale yellowish brown; veins brown. Macrotrichia abundant on veins beyond cord but lacking on Rs; squama naked. Venation: $R_{1+2}$ elongate, with trichia on basal two-thirds; petiole of cell $M_1$ exceeding m; $M_{3+4}$ subequal to basal section of $M_{1+2}$; m-cu just beyond origin of $M_4$.

Basal tergite chiefly buffy; succeeding tergites dark gray, narrowly margined laterally and caudally with yellow; hypopygium pale reddish; sternites almost uniformly gray. Male hypopygium (Plate 3, fig. 35) with the tergite, 9*t*, separated from the sternite, 9*s*; basistyle, *b*, and sternite chiefly fused, but with the suture indicated though delicate. Ninth tergite (Plate 3, fig. 36, 9*t*) with lateral lobes of unusual length, the median region of the notch produced into a low obtuse mound; lobes with the setæ sparse, erect or even retrorse at near midlength. Basistyle with outer end gradually narrowed to a subacute spinous point, on ventral surface with several elongate setæ. Outer dististyle (Plate 3, fig. 35, *od*) relatively slender, the distal two-thirds dilated into a weak blade, with abundant conspicuous setæ. Inner dististyle, *id*, with the outer margin at base prolonged into a flattened lobe. Membrane between eighth, 8*s*, and ninth sternites, 9*s*, with a median group of long yellow setæ, directed chiefly ventrad.

*Female.*—Generally as in male but subapterous. Mesonotal præscutum more buffy gray. Wings short and obtuse; venation distinct but distorted; costal margin with unusually abundant black trichia, darkening the border. Ovipositor with the cerci and hypovalvæ elongate, the tips of the latter more obtuse.

*Habitat.*—Kashmir.

Holotype, male, Baltistan, altitude 11,800 feet, August 2, 1934 (*Hutchinson*). Allotopotype, female, with the type. Paratopotypes, 5 males, 1 female, July 10 to August 2, 1934.

The present species is very different from other clear-winged species of the genus having nearly apterous females. The chief specific characters are to be found in the male hypopygium, notably of the tergite. The specific name, *icarus*, is in allusion to the flightless condition of the female.

### TIPULA (LUNATIPULA) SUBMARMORATIPENNIS sp. nov. Plate 3, figs. 37, 38.

Belongs to the *marmoratipennis* group; general coloration of mesonotal præscutum light gray, with four darker gray stripes that are narrowly margined with light brown; antennæ bicolorous; pleura yellow, in cases with the dorsal sclerites darkened; femora, tibiæ, and basitarsi yellow, their tips narrowly blackened; wings yellow to brownish yellow, marmorate with brown and gray areas; abdomen fulvous, the tergites narrowly trivittate with black, without silvery areas; terminal segments in male darkened; male hypopygium with eighth sternite moderately sheathing, with lateral brushes of setæ, the median area with abundant small spinous points.

*Male.*—Length, 16 to 20 millimeters; wing, 21 to 26.

*Female.*—Length, 23 to 27 millimeters; wing, 25 to 30.

Frontal prolongation of head yellow above, darker laterally; nasus powerfully developed; palpi with basal three segments and proximal end of last dark brown, the remainder of terminal segment light yellow. Antennæ with scape and pedicel yellow;

flagellar segments bicolorous, the basal enlargements dark brown, the remainder brownish yellow, on outer segments more uniformly darkened; verticils exceeding the segments in length. Head buffy, overcast with light gray, the orbits brighter; a narrow dark brown vitta extends from the summit of the entire vertical tubercle almost to occiput.

Mesonotal præscutum light gray, with four darker gray stripes that are narrowly margined with light brown; setigerous punctures of interspaces relatively conspicuous; scutum light gray, the lobes variegated by darker gray; scutellum and mediotergite gray, with a very conspicuous, dark brown, median stripe. Pleura yellow, including the dorsopleural membrane, this latter darker in females; sternopleurite with pale setæ. Halteres buffy, the knobs dark brown with pale apices. Legs with the coxæ and trochanters pale yellow; femora yellow, the tips narrowly blackened; tibiæ and basitarsi pale yellow, the tips narrowly darkened, the outer tarsal segments black. Wings with the ground color yellow (female) to brownish yellow (male), variegated with brown and gray washes, arranged about as in the *marmoratipennis* group; conspicuous brown clouds at ends of longitudinal veins; an oblique pale yellow line at near midlength of cell M, separating two pale brown washes; veins brown, more yellow in the female. Venation: Cell 1st $M_2$ strongly pointed at inner end; petiole of cell $M_1$ short; m-cu strongly arcuated, placed before midlength of cell 1st $M_2$.

Abdominal tergites fulvous, narrowly trivittate with brownish black, the terminal segments (male) brownish black, sparsely pruinose; in female, abdomen more uniformly brightened, the dark vittæ very narrow, the terminal segments weakly darkened; no silvery patches on abdomen, as is the case in allied species. Male hypopygium (Plate 3, fig. 37) with the tergite, 9*t*, separated from the sternite, 9*s*, by an incomplete suture. Ninth tergite (Plate 3, fig. 38, 9*t*), viewed from above, with a pair of low sublateral tubercles that are tipped with a brush of long coarse black setæ; and a pair of submedian tubercles similarly clothed with short spinous setæ; viewed from the side, a blackened point protrudes caudad. Outer dististyle (Plate 3, fig. 38, *od*) boomerang-shaped, at apex with three or four black spines. Inner dististyle (Plate 3, fig. 38, *id*) arcuate, the distal half narrowed into a slender blackened point, the outer margin with long coarse setæ. Eighth sternite (Plate 3, fig. 37, 8*s*) only slightly sheathing; apex subtruncate, each outer angle with a brush of scanty long yellow setæ; the broad median area is abundantly dotted with tiny, blackened, peglike spines. Ovipositor with short, fleshy, divergent valves, as in the group.

*Habitat.*—Kashmir.

Holotype, male, Upper Pulwar Nullah, altitude 11,000 feet, October 2, 1934 (*Hutchinson*). Allotype, female, Lower Pulwar Nullah, altitude 9,000 feet, October 12, 1934, came to light in tent; camp in walnut grove near spring (*Hutchinson*). Paratopotype, 1 female, with type; paratypes, 1 male, 1 female, with the allotype.

The nearest regional ally is *Tipula* (*Lunatipula*) *marmoratipennis* Brunetti (Darjiling, eastern Himalayas, altitude 7,000 feet, May and August). I have been privileged to study both the holotype and paratype specimens of this latter species and have provided supplementary details of structure and coloration in another paper. The latter fly has the antennal flagellum almost uniform obscure yellow, scarcely bicolorous; tibiæ and tarsi brownish black; basal five abdominal tergites orange-fulvous (female), trivittate with black, the segments with silvery gray lateral areas; outer abdominal segments darker brown, heavily pruinose.

**TIPULA (LUNATIPULA HYPOVALVATA sp. nov.** Plate 1, fig. 10; Plate 3, figs. 39, 40.

General coloration of præscutum yellowish gray, with two narrow brown intermediate stripes; pleura yellow; antennæ bicolorous; wings strongly tinged with brownish yellow, obliterative areas restricted; basal segments of abdomen yellow, in female with conspicuous brown lateral stripes; subterminal segments of abdomen darkened; male hypopygium with caudal margin of tergite trilobed; basistyle produced into an obtuse flattened lobe; a long setiferous lobe in membrane between eighth and ninth tergites; female with hypovalvæ reduced to slender dark spines.

*Male.*—Length, 13 to 13.5 millimeters; wing, 12.5 to 13.5.

*Female.*—Length, about 19 millimeters; wing, 15.

Frontal prolongation of head yellow, scarcely darker laterally; nasus distinct; palpi brown, the relatively short terminal segment darker brown. Antennæ (male) moderately elongate, if bent backward extending nearly to root of halteres; basal three segments yellow, the succeeding segments bicolorous, the basal enlargements dark, the terminal segments more uniformly darkened. Head brownish gray, the front and posterior orbits somewhat clearer gray.

Mesonotal præscutum yellowish gray, with two narrow brown intermediate stripes, their anterior ends subobsolete and passing into gray; scutum yellowish gray, the scutellum and mediotergite clearer yellow. Pleura yellow, including the dorsopleural membrane. Halteres infumed. Legs with the coxæ and trochanters light yellow; femora yellow, the tips very narrowly and indistinctly darkened; tibiæ brownish yellow, the tips very narrowly infuscated; tarsi passing through obscure yellow to black. Wings (Plate 1, fig. 10) with a strong and almost uniform brownish yellow tinge, cell Sc clearer yellow, cell C more brownish yellow; stigma pale brown; obliterative areas before the stigma and along cord very restricted, beyond the stigma scarcely evident; veins pale brown. Squamal setæ from five to seven in number, strong; trichia of veins beyond cord relatively short but numerous. Venation: $R_{1+2}$ entire; cell 1st $M_2$ elongate, its outer end somewhat pointed by the obliquity of m, the latter longer than the petiole of cell $M_1$.

Abdomen (male) yellow, the seventh to ninth tergites blackened; sternite seven blackened basally and at sides, the caudal portion pale; ninth sternite paler; a very indistinctly darker lateral stripe on tergites. What evidently represents the female of this same species has the abdomen quite different in pattern, the tergites with a very broad and conspicuous brownish black lateral stripe; tergites seven to nine more uniformly blackened; tergal shield more polished chestnut-brown; cerci relatively strong, nearly straight, the valves lying obliquely or subtransversely; hypovalvæ reduced to slender dark spines, their tips more or less convergent. Male hypopygium (Plate 3, fig. 39) with the tergite, *9t*, entirely separated from the sternite, *9s*, by a suture. Ninth tergite (Plate 3, fig. 40, *9t*) with the caudal margin trilobed, the lateral lobes longer but slender; a smaller, more-depressed, median lobe at end of a U-shaped dorsal depression. Basistyle, *b*, with the ventral suture well indicated, the apical portion of the sclerite produced into an obtuse flattened lobe. Outer dististyle (Plate 3, fig. 40, *od*) slender, with abundant setæ on distal half. Inner dististyle, *id*, with a complex setiferous lobe at base of outer portion. A fleshy cushion on membrane between the eighth, *8s*, and ninth, *9s*, sternites, provided with long conspicuous yellow setæ.

*Habitat.*—Kashmir.

Holotype, male, Sind Valley, altitude 9,000 feet, June 14, 1934 (*Hutchinson*). Allotopotype, female. Paratopotype, male;

paratypes, 3 males, without exact locality, altitude 9,000 feet, August 21, 1934 (*Hutchinson*).

The present species is most closely allied to *Tipula* (*Lunatipula*) *manca* Alexander and *T.* (*L.*) *terebrina* Alexander, differing especially in the venation, coloration of the wings, and details of structure of the male hypopygium. The structure of the ovipositor is very peculiar.

**TIPULA XANTHOCERA** sp. nov. Plate 1, fig. 11; Plate 3, figs. 41, 42.

Allied to *ligulifera;* mesonotal præscutum brown, with four grayish brown stripes; antennæ (male) elongate, approximately one-half as long as body, the basal segments yellow, the outer segments bicolorous, the basal enlargement of each segment yellow, the apical portion darker; femora and tibiæ yellow, the tips narrowly blackened; wings broad, strongly suffused with yellow; cell $M_1$ short-petiolate; abdomen yellow, the tergites trivittate with black, the lateral stripes very broad and conspicuous; a subterminal black ring; male hypopygium with a tooth on mesal face of outer dististyle; a conspicuous flattened lobe at extreme base of ninth sternite.

*Male.*—Length, about 12 millimeters; wing, 10.5; antenna, about 6.

Frontal prolongation of head relatively short, entirely yellow; nasus distinct; palpi brownish yellow. Antennæ (male) elongate; basal half yellow, the outer segments bicolorous, with the basal enlargements of the individual segments light yellow, the long apical pedicels pale brown; flagellar segments feebly incised; verticils shorter than the segments. Head yellowish brown, with a faint gray cast.

Mesonotal præscutum brown, with four grayish brown stripes that are poorly defined against the ground; scutal lobes grayish brown, the median region and posterior portions of the lobes a trifle brightened; scutellum yellowish gray; mediotergite brownish yellow. Pleura uniformly pale yellow. Halteres yellow, the base of knob weakly darkened. Legs with the coxæ and trochanters pale yellow; femora and tibiæ yellow, the tips narrowly but conspicuously blackened; basitarsi brown, passing into black; remainder of tarsi black; claws simple. Wings (Plate 1, fig. 11) broad, uniformly suffused with yellow, the prearcular and costal fields more saturated yellow; stigma small, pale brown; veins yellow. Venation: Rs short, subequal to m-cu; $R_2$ relatively long; $R_{1+2}$ entire, very gently diverging from $R_3$; petiole of cell $M_1$ very short; cell 1st $M_2$ parallel-sided or slightly narrowed at distal end; $M_{3+4}$ very short; m-cu joining $M_4$ some distance beyond origin of latter.

Abdomen yellow, the tergites trivittate with brownish black, the median stripe very narrow and paler; lateral stripes broad and intense; all stripes beginning at base of tergite two, lateral stripes continuous, widening behind; segments seven and eight entirely black, the hypopygium chiefly paler; sternites pale yellow, the subterminal segments weakly darkened. Male hypopygium (Plate 3, fig. 41) small, the tergite, 9*t*, entirely separated from the elongate sternite-basistyle, 9*s*, by membrane; median notch of sternite with a tumid U-shaped setiferous lobe on posterior half. Ninth tergite (Plate 3, fig. 42, 9*t*) extensive, flattened, the caudal margin with a broad V-shaped notch, with a small, pale, triangular point at base; mesal margins of lobes set with blackened peglike spines; ventral surface of tergite with extensive and conspicuous lobes and projections. Outer dististyle (Plate 3, fig. 42, *od*) narrow, on inner face at near midlength with a very conspicuous erect black spine. Inner dististyle as shown (Plate 3, fig. 42, *id*); posterior margin near base with a small setiferous lobe. At extreme cephalic end of ninth sternite a conspicuous flattened pale ligula (Plate 3, fig. 41, 9*s*), slightly obovate in outline, the apex truncated to very weakly emarginate medially; surface with abundant delicate setæ.

*Habitat.*—Kashmir.

Holotype, male, Gurais, altitude 7,000 feet, September 15, 1934 (*Hutchinson*).

The nearest ally of the present fly is *Tipula ligulifera* Alexander (eastern Siberia), which differs in the narrower wings, short antennæ, and details of coloration and structure of the male hypopygium. I am still unable to place these species in a subgeneric group, but am inclined to believe that they may best be placed in *Yamatotipula*. The resemblance to species of the *luteipennis* group of the typical subgenus is superficial only.

**NEPHROTOMA INCONSEQUENS** sp. nov. Plate 1, fig. 12; Plate 4, fig. 43.

Size small; flagellar segments (male) strongly binodose; pronotum orange; præscutum orange, with three highly polished black stripes; mediotergite and pleura orange; femora yellow, the tips very narrowly dark brown; wings subhyaline, stigma pale, ill-delimited; no stigmal trichia; abdomen orange, the seventh tergite and eighth sternite variegated by dark brown; male hypopygium with the inner dististyle without dorsal crest; eighth sternite gently emarginate medially, the broad lobes with sparse strong setæ; gonapophyses about twice as long as wide, the tips obtuse.

*Male.*—Length, about 9 millimeters; wing, 8.5.

Frontal prolongation of head light brown, including nasus; palpi dark brown, the terminal segment brownish black. Antennæ with the basal three segments yellowish brown, the remainder black; flagellar segments very strongly incised, the outer swelling longer and almost as high as the basal enlargement; verticils shorter than the segments, those on ventral face of enlargement very short. Head deep fulvous-brown; occipital brand small, poorly differentiated from the ground; vertex with a reticulate pattern of delicate blackish lines; vertical tubercle entire.

Pronotum deep orange. Mesonotal præscutum deep orange, with three highly polished black stripes that are not bordered by a different color; lateral stripes straight but with a paler brown suffusion laterad of their anterior ends; scutum obscure yellow, each lobe with two confluent polished black areas; scutellum brown, the parascutella a little more orange; mediotergite dull orange, the posterior border with paired darker spots. Pleura dull orange-yellow, vaguely darker on ventral sternopleurite. Halteres dusky. Legs with the coxæ obscure yellow, with long conspicuous yellow setæ; trochanters yellow; femora yellow, the tips very narrowly and indistinctly darker brown; tibiæ brownish yellow, the tips narrowly darkened; tarsi black. Wings (Plate 1, fig. 12) subhyaline; cell Sc a little darker; stigma pale, ill-delimited, the caudal edge a trifle darker; veins brown. Stigma without trichia. Venation: $Sc_2$ ending opposite origin of Rs, $Sc_1$ represented by a spur; cell $M_1$ narrowly sessile; cell 1st $M_2$ gently widened outwardly; m-cu at fork of $M_4$, the latter a little basad of $M_3$.

Abdomen orange; tergites unmarked medially except for the seventh segment, which is blackened except laterally at base; a narrow but conspicuous brownish black stripe on lateral margins of tergites from segments two to four, inclusive; sternites yellow, unmarked, except for the basal third of the eighth sternite, which is dark brown; hypopygium orange-yellow. Male hypopygium with the ninth tergite (Plate 4, fig. 43, 9*t*) having strong sclerotized lateral horns, divergent, each with about three black peglike spines on basal half of mesal face; lobes of tergite truncated, separated by a small U-shaped notch, their surface with abundant black spines and spinous setæ. Outer dististyle, *od,* of moderate size, the apical point short. Inner dististyle, *id,* without dorsal crest; apical beak long and slender; posterior margin of style with two powerful setæ, additional to the abundant pale normal setæ. Eighth sternite, 8*s,* with the caudal margin gently notched medially, the broad obtuse lobes with stronger and more abundant setæ, directed caudad and mesad. Gonapophyses, *g,* appearing as small flattened blades, oval in outline, about twice as long as wide and much shorter than the ædeagus, the tips obtuse.

*Habitat.*—Central Celebes (Bontoe Batoe District).

Holotype, male, Latimodjong Mountains, altitude 4,500 to 6,000 feet, May 25, 1931 (*Clagg*).

Among the more than one hundred described species of *Nephrotoma* in eastern Asia and the Malayan Islands, the present fly is best distinguished by the combination of small size, strongly binodose flagellar segments in the male, highly polished præscutal stripes, virtually immaculate mediotergite and pleura, lack of stigmal trichia, and the almost unmarked abdomen. The details of structure furnish additional characters to separate the fly from other regional small-sized members of the genus.

**NEPHROTOMA PARASCUTELLATA** sp. nov. Plate 1, fig. 13; Plate 4, fig. 44.

General coloration yellow; mesonotal præscutum with three black stripes, the lateral pair outcurved at anterior ends; scutellum yellow, parascutella black; mediotergite yellow, the posterior third blackened; orbital darkening appearing as elongate dashes; halteres black; legs black, the femoral bases narrowly yellow; wings subhyaline, the stigma and cells Sc and $Cu_1$ brownish black; intermediate abdominal segments yellow, with black posterior triangles, the outer segments and hypopygium black; eighth sternite of male hypopygium weakly emarginate.

*Male.*—Length, about 12 to 13 millimeters; wing, 10 to 10.5.

*Female.*—Length, about 15 millimeters; wing, 11.5 to 12.

Frontal prolongation of head obscure yellow, darker ventrally beneath and on sides; nasus and an adjoining area brownish black; palpi black. Antennæ with scape yellow; pedicel dark brown; flagellum black; antennæ (male) of moderate length, if bent backward extending about to root of halteres; flagellar segments moderately incised, with verticils that are shorter than the segments. Head orange-yellow, clearer yellow in front; occipital brand small and only feebly differentiated from the ground; orbital darkenings appearing as elongate dashes extending from the narrowest point of the vertex caudad, gradually diverging from the eye margin.

Pronotum light yellow, the sides extensively blackened. Mesonotal præscutum yellow, more orange-yellow on interspaces; three black stripes, the surface feebly nitidous, the lateral stripes outcurved to margin; scutum broadly yellow medially, the lobes extensively black, the color extended laterad and including the outer ends of suture, restricting the lateral yellow areas of the præscutum to small spots before the suture; scutellum light yellow, the parascutella conspicuously black, contrasting markedly with the scutellum; mediotergite clear light yellow, with about the posterior third brownish black. Pleura yellow, the anepisternum and ventral sternopleurite more reddish; pleurotergite black on dorsal and ventral portions, isolating a central pale yellow area. Halteres black, the knobs not or scarcely brightened. Legs with the coxæ and trochanters yellow; femora black, the bases somewhat narrowly yellow, more extensive on the fore and middle legs where about the basal fourth or fifth is brightened, much narrower on posterior femora; tibiæ brownish black; tarsi black. Wings (Plate 1, fig. 13) subhyaline; cell Sc and the stigma brownish black; cell $Cu_1$ (between the approximated branches of Cu) darkened; veins brownish black. Stigmal trichia variable in number, in males ranging to 15 or 18; in female almost lacking. Venation: $Sc_2$ ending approximately opposite the origin of Rs; cell $M_1$ short-petiolate to barely sessile.

Abdomen with basal tergite chiefly black; tergites two to five yellow, with black posterior triangles; outer segments, including hypopygium, black; shield of ovipositor black. Male hypopygium with the lateral horns of tergite (Plate 4, fig. 44, 9*t*) short and entirely pale, earlike, with three or four small spinous points on base; median notch small. Outer dististyle, *od*, small, the apex little-attenuated. Inner dististyle, *id*, with apical beak stout; dorsal crest lacking or indicated only by a weak protuberance; setæ of style short but black and conspicuous. Eighth sternite with median area gently emarginate, the broadly rounded lateral lobes with long pale yellow setæ.

*Habitat.*—West Java.

Holotype, male, Mount Malang, altitude 3,000 feet, August, 1933 (*Walsh*). Allotype, female, Buitenzorg, December, 1930

(*Handschin*), in the Natural History Museum, Basel, Switzerland. Paratopotypes, males, with the holotype.

The present fly bears a general resemblance to species such as *Nephrotoma doleschalli* (Osten Sacken) and *N. javana* (Wiedemann), but is unquestionably distinct from these and other regional species. The most characteristic features lie in the nature of the orbital darkenings, the black parascutella, the dark halteres and legs, and the pattern of the abdomen, with all outer segments, including hypopygium, blackened.

**NEPHROTOMA MERACA** sp. nov. Plate 1, fig. 14; Plate 4, fig. 45.

General coloration yellow, the præscutum with three polished black stripes, the lateral pair outcurved; antennæ bicolorous, with the bases of the flagellar segments reddish yellow, the remainder black; occipital brand large and conspicuous, more or less heart-shaped; a central dark longitudinal stripe on mediotergite; apices of knobs of halteres yellowish white; femora yellow, the tips narrowly but conspicuously blackened, the amount subequal on all legs; wings subhyaline, the stigma dark brown; wing tip and cord narrowly darkened; abdominal tergites yellow, with three broken black stripes; terminal segments darkened; male hypopygium with a long rectangular lobe from beneath the eighth sternite, its apex with a rounded notch.

*Male.*—Length, about 9 millimeters; wing, 9; antenna, about 5.

Frontal prolongation of head light yellow, the nasus and a small adjacent area blackened; palpi with basal segment obscure yellow; succeeding segments brown, terminal segment yellow. Antennæ moderately elongate; scape yellow, pedicel brown; basal flagellar segment black; flagellar segments beyond the first bicolored, the basal enlargement reddish yellow, the remainder black; outer segments more uniformly darkened; flagellar segments moderately incised; verticils shorter than the segments. Head yellow, the occipital brand large and conspicuous, more or less heart-shaped.

Pronotum yellow medially, broadly brownish black on sides. Mesonotal præscutum obscure yellow, with three polished black stripes that are not bordered by darker; lateral stripes outcurved, but the bent portion paler than the stripe itself; scutum yellow, each lobe with two black areas, the more anterior extended laterad along the suture; scutellum and parascutella obscure yellow; mediotergite yellow, with a faint median darkening, in type restricted to cephalic portion, in paratype continuous.

Pleura pale yellow, indistinctly variegated by more reddish areas on anepisternum and ventral sternopleurite. Halteres brownish yellow, the base of knob darkened, the apex broadly yellowish white. Legs with the coxæ orange, the base of fore coxa narrowly darkened; trochanters obscure yellow; femora yellow, the tips very indistinctly darkened; tarsi black. Wings (Plate 1, fig. 14) relatively broad, subhyaline; stigma oval, dark brown; a narrow brown seam on anterior cord; wing tip obtuse, narrowly margined with brown; a very narrow brown seam on vein $M_4$ to margin; other veins beyond cord less distinctly seamed; cell Sc entirely clear; veins brown. Only about four stigmal trichia. Venation: Sc relatively long, $Sc_2$ ending about opposite one-third the length of the relatively long Rs, $Sc_1$ indicated by a spur; cell $M_1$ sessile; m-cu at fork of $M_4$, the latter some distance before fork of $M_3$.

Abdomen yellow, the tergites with three broken black stripes, interrupted at basal portions of segments; caudal end of seventh tergite, eighth segment, and part of ninth segment black; remainder of hypopygium light brown; sternites yellow, the seventh and eighth segments blackened. Male hypopygium with the ninth tergite (Plate 4, fig. 45, 9*t*) having caudal border with two broadly truncated lobes, the dorsal surface on either side elevated into blackened mounds, the median portion more reddish. Outer dististyle, *od*, yellow, the tip obtuse. Inner dististyle, *id*, with the beak very obtuse. From beneath the eighth sternite projects a small, long-rectangular, pale lobe, 8*s*, its apex with a small circular notch. Gonapophyses greatly reduced so as to be virtually lacking.

*Habitat.*—Kashmir.

Holotype, male, Baltistan, altitude 10,000 feet, June, 1934 (*Hutchinson*); came to light in tent in willow grove near glacier. Paratopotype, male.

The only other regional species having the coloration of the antennæ approximately as in the present fly is *Nephrotoma puncticornis* (Brunetti), of the eastern Himalayas, which is entirely different in the coloration of the head and body, having the præscutal stripes straight and the mediotergite bright light yellow, while the abdomen is chiefly yellow.

**NEPHROTOMA TRILOBULATA** sp. nov. Plate 1, fig. 15; Plate 4, fig. 46.

General coloration yellow, variegated with black; antennal flagellum black, the segments only weakly incised; a small dark spot before antennal bases; occipital brand large; lateral præscutal stripes outcurved at anterior ends; wings yellowish subhyaline; stigma pale, only a little darker than the ground; cell Sc undarkened; stigmal trichia sparse; vein $Sc_2$ ending opposite origin of Rs; abdomen orange-yellow, the tergites interruptedly trivittate with black; hypopygium pale; male hypopygium with a depressed rectangular lobe from beneath the posterior margin of the eighth sternite, its apex trilobulate.

*Male.*—Length, 12.5 to 13 millimeters; wing, 11 to 12.

*Female.*—Length, about 15 to 16 millimeters; wing, 12.5 to 14

Frontal prolongation of head orange-yellow, the long nasus and a dorsal suffusion of the prolongation pale brown; palpi dark brown, the terminal segment somewhat paler. Antennæ with scape orange, remainder of organ black; flagellar segments only weakly incised; verticils shorter than the segments. A small bright brown triangular area on front before the antennal bases; posterior region of head orange, the orbits and genæ yellow; occipital brand large and conspicuous, shiny, narrowly bordered by opaque, in cases the anterior end sending a more or less entire prolongation to summit of tubercle; a very small and indistinct dark spot on anterior orbit opposite the narrowest point of vertex.

Pronotum yellow medially, conspicuously black on sides. Mesonotal præscutum yellow, with three polished black stripes, the lateral pair outcurved; median stripe crossing the suture behind; scutum yellow, the lobes conspicuously variegated with black, sending a narrow line across the suture and connecting with the lateral præscutal stripes; scutellum brown, parascutella yellow, narrowly blackened on mesal portion adjoining the scutellum; mediotergite pale yellow, with a median dark area that is narrower but darker on cephalic half of sclerite, on posterior half expanded and paling to light brown. Pleura sulphur yellow on anepisternum and sternopleurite, variegated with reddish brown areas; propleura and posterior sclerites of mesopleura more china white; a linear black area on suture between the anepisternum and sternopleurite. Halteres dark brown, the base of stem narrowly reddish, the apex of knob sulphur yellow. Legs with the coxæ yellow, the fore and middle coxæ more variegated with reddish; trochanters yellow; femora orange-yellow, the tips very narrowly and insensibly darkened; tibiæ light brown, passing into brownish black; tarsi black. Wings (Plate 1, fig. 15) yellowish subhyaline; stigma pale, only a little darker than the ground; cell Sc scarcely darker than cell C; veins brown. Stigmal trichia about six in number. Venation: $Sc_2$ ending opposite origin of Rs, $Sc_1$ preserved; cell $M_1$ narrowly sessile to short-petiolate; m-cu just before fork of $M_4$.

Abdomen orange-yellow, the tergites narrowly trivittate with black, the stripes interrupted at posterior border of each segment; outer segments almost uniformly pale, the outer end of the seventh tergite and basal portion of the eighth infuscated; hypopygium pale. Male hypopygium with the tergite (Plate 4, fig. 46, 9*t*) bearing two divergent lobes, separated by a V-shaped notch, the margins of the lobes provided with a series of blackened points and spinous setæ. Outer dististyle, *od*, moderately attenuated. Inner dististyle, *id*, with the apical beak slender; dorsal crest low. From beneath the caudal margin of the eighth sternite a rectangular depressed lobe, 8*s*, its apex trilobulate, the lateral lobules a little longer and more slender than the median one.

*Habitat.*—Kashmir.

Holotype, male, Baltistan, altitude 9,000 feet, June 20, 1934 (*Hutchinson*). Allotopotype, female, pinned with type. Paratopotype, 1 male; paratype, 1 female, altitude 10,000 feet, June 14, 1934.

Apparently most closely allied to *Nephrotoma consimilis* (Brunetti), which differs conspicuously in the small occipital brand, chiefly blackened femora, darkened terminal segments of abdomen, and structure of the hypopygium. It is evident that Brunetti had at least two species confused in the type series and original description of *consimilis.* I possess several paratype and metatype specimens received from Mr. Brunetti and am basing the above comparison upon paratypical material.

**NEPHROTOMA IRREVOCATA** sp. nov. Plate 1, fig. 16; Plate 4, fig. 47.

General coloration yellow, variegated by black; frontal prolongation of head with a narrow black median stripe; terminal segment of palpus yellow; antennal flagellum black; lateral præscutal stripes decurved; mediotergite with an inverted T-shaped brown area; knobs of halteres sulphur yellow; fore femora chiefly black, the remaining femora yellow, narrowly tipped with black; wings subhyaline, cell Sc and the stigma darkened; abdominal tergites orange-yellow, with three narrow black stripes, the seventh to ninth segments black; male hypopygium with the lateral horns of tergite small and acute, without spines; gonapophyses elongate.

*Male.*—Length, 11 to 12 millimeters; wing, 11 to 11.5.

Frontal prolongation of head yellow; nasus and a narrow but complete line on dorsum brownish black; palpi testaceous-yellow, the basal three segments in cases somewhat darker. Antennæ with scape and pedicel brownish yellow, flagellum black; flagellar segments moderately incised; verticils a little shorter than the segments. Front sulphur yellow, posterior portion of head more orange; occipital brand of moderate size, dark brown, sending an anterior prolongation part way up the high vertical tubercle; a more or less evident dark spot on anterior orbit at narrowest point of vertex.

Pronotum pale yellow, dark brown on sides. Mesonotal præscutum yellow, with three polished black stripes that are not or scarcely bordered by duller black; lateral stripes outcurved to margin, the decurved portion variable in intensity, in cases much paler than the stripes; scutum yellow, each lobe virtually covered by a large black area that follows the suture to the lateral border; scutellum pale brown, the parascutella yellow; mediotergite yellow, with an inverted T-shaped brown area, the crossbar sometimes paler than the stem. Pleura yellow, variegated by reddish on anepisternum, ventral sternopleurite, and meron; a brown or black dash on posterior portion of anepisternum. Halteres dusky, the base of stem narrowly reddish, the knobs chiefly bright sulphur yellow. Legs with the coxæ whitish, with more or less distinct reddish tinges; trochanters yellow; fore femora chiefly black, the basal third yellow; middle and hind femora yellow, the tips narrowly black, the amount involving about the distal eighth or less; tibiæ dark brown, the tips narrowly darker; tarsi black. Wings (Plate 1, fig. 16) subhyaline or with a very faint dusky tinge; cell Sc uniformly darkened; stigma dark brown; cell $Cu_1$ and wing tip less clearly darkened; veins dark brown. Stigmal trichia scanty, six to eight in number. Venation: Cell $M_1$ sessile; m-cu a short distance before fork of $M_4$.

Abdominal tergites orange-yellow, with three narrow black stripes, more or less interrupted at the incisures, in male with the seventh and succeeding segments intense black, only the outer dististyle pale yellow; impressed areas on basal rings of tergite distinct, confluent with the median dark stripe. Male hypopygium with the tergite (Plate 4, fig. 47, 9*t*) small, the caudal margin concave, with a submedian lobe on either side, the notch between long and narrow; margins of lobes set with microscopic blackened points and setæ; a smooth acute yellow blade on either side of caudal portion; dorsal setæ restricted to posterior half of sclerite. Styli, *id, od,* as figured. Gonapophyses, *g,* long and slender, the distal half somewhat narrower than the base. Eighth sternite entire, with a small, pale, fleshy lobule protruding from beneath its margin.

*Habitat.*—Kashmir.

Holotype, male, Baltistan, altitude 10,000 feet, June, 1934 (*Hutchinson*). Paratopotypes, 2 males, with the type; 1 male, altitude 10,000 feet, June 22, 1934; 2 males, altitude 9,000 feet, June 19, 1934; 1 male, altitude 8,000 feet, June 19, 1934; came to light in tent at 8 p. m., at camp beside Dras River (*Hutchinson*).

By means of keys to the regional species of *Nephrotoma,* the present fly runs to *N. consimilis* (Brunetti) and *N. virgata* (Coquillett). The former differs conspicuously in the strongly tinted wings, with pale stigma and cell Sc, together with an entirely different male hypopygium. *Nephrotoma virgata* likewise has the stigma and cell Sc pale and with the hypopygium quite distinct in all details, more notably in the straplike appendage from behind the eighth sternite.

## LIMONIINÆ

### LIMONIINI

#### LIMONIA (LIMONIA) PROTRUSA sp. nov. Plate 1, fig. 17.

Rostrum yellow; antennæ relatively elongate; flagellum black; mesonotal præscutum with entire disk covered by a brownish black shield, the humeral region obscure yellow; legs dark brown; wings with a strong brown tinge; stigma long-oval, darker brown; $Sc_1$ ending about opposite two-thirds the length of Rs, $Sc_2$ at its tip; $R_{1+2}$ jutting far beyond level of free tip of $Sc_2$ and $R_2$, which are both pale and lie in approximate transverse alignment; vein $Sc_2 + R_1$ bending strongly caudad as it enters the region of the stigma; m-cu at fork of M; abdominal tergites brownish black, the sternites somewhat paler with the bases of the segments narrowly darker.

*Female.*—Length, about 6 millimeters; wing, 6.8.

Rostrum yellow; palpi black. Antennæ with scape and pedicel obscure brownish yellow; flagellum black; antennæ relatively elongate (for female sex); flagellar segments cylindrical, with short apical pedicels; terminal segment about one-third longer than the penultimate. Head dark gray.

Pronotum reduced, yellow, becoming darker on sides. Mesonotal præscutum with the disk chiefly covered by a brownish black shield, the humeral region obscure yellow; scutal lobes dark brown, the median area vaguely brightened; posterior sclerites of mesonotum dark brown. Pleura with dorsal half darker brown than the ventral yet not forming a dorsal stripe, the suffusion chiefly appearing on the ventral anepisternum. Halteres dusky, the base of stem restrictedly pale. Legs with the fore coxæ darker than the other coxæ; trochanters obscure yellow; remainder of legs dark brown, the femoral bases very restrictedly pale. Wings (Plate 1, fig. 17) with a strong brown tinge; stigma long-oval, darker brown; veins brown $R_2$ and the free tip of $Sc_2$ pale and without trichia. Venation: Sc long, $Sc_1$ ending about opposite two-thirds the length of Rs, $Sc_2$ close to its tip; $R_{1+2}$ projecting beyond free tip of $Sc_2$ as a long spur that is provided with about a dozen trichia; free tip of $Sc_2$ and $R_2$ virtually in transverse alignment; vein $Sc_2 + R_1$ bending strongly caudad as it enters the region of the stigma; inner end of cell 1st $M_2$ slightly arcuated; m-cu at fork of M; anal veins convergent near origin, 2d A weakly sinuous.

Abdominal tergites brownish black, the sternites a trifle paler, with the bases of the intermediate segments rather narrowly darker; cerci very slender, the tips simple; hypovalvæ horn-yellow, the bases blackened.

*Habitat.*—China (Chekiang).

Holotype, female, hills back of Ning-po, halfway to Nimrod Sound, May 1, 1925 (*Suenson*).

The peculiar venation of the radial field, with vein $R_{1+2}$ jutting far beyond the free tip of $Sc_2$, is a very uncommon condition in the typical subgenus, in the local fauna being found only in *Limonia* (*Limonia*) *monacantha* Alexander, which is entirely distinct in the conspicuously patterned wings.

**LIMONIA (LIMONIA) LATICELLULA Alexander.**

*Limonia* (*Limonia*) *laticellula* ALEXANDER, Philip. Journ. Sci. 49 (1932) 381–382.

Described from Szechwan, western China, altitude 6,000 to 11,000 feet, July, 1931 (*Franck*). Three males and females, near Bandapur, Kashmir, altitude 7,000 feet, November 4, 1934, flying beneath fir trees (*Hutchinson*).

**LIMONIA (LIMONIA) HOSTILIS Alexander.**

*Limonia* (*Limonia*) *hostilis* ALEXANDER, Philip. Journ. Sci. 51 (1933) 533–534.

Described from the Szechwan-Tibet border, at high altitudes, August 3 to 6, 1930 (*Graham*). Several males and females, Mount Omei, Szechwan, altitude 10,800 to 11,000 feet, August 16 to 20, 1934 (*Graham*). One female, Bitzal Nullah, western Karakorams, Kashmir, altitude 14,000 feet, September 2, 1934 (*Hutchinson*).

**LIMONIA (DICRANOMYIA) TRICUSPIDATA sp. nov.** Plate 1, fig. 18; Plate 4, fig. 48.

Allied to *immodestoides;* general coloration grayish brown; knobs of halteres darkened; femora and tibiæ pale brown, the tarsi brownish black; wings subhyaline, the short-oval stigma pale brown; $Sc_1$ longer than Rs; cell 1st $M_2$ open by atrophy of m; vein $M_{3+4}$ longer than $M_4$; male hypopygium with the caudal margin of tergite deeply emarginate; ventral dististyle large and fleshy, its rostral prolongation with three subequal spines near base.

*Male.*—Length, about 6 millimeters; wing, 6.8 to 7.

*Female.*—Length, about 6 millimeters; wing, 7.

Rostrum brownish yellow to brown, the palpi only a little darker. Antennæ short, black throughout; flagellar segments short-oval, the outer segments somewhat longer; terminal segment approximately one-half longer than the penultimate. Head dark brownish gray.

Pronotum dark medially, paler on sides. Mesonotal præscutum dark grayish brown medially, the humeral region brighter; scutal lobes darkened, the median region paler; posterior sclerites of notum grayish brown. Pleura chiefly darkened, pruinose. Halteres pale, the knobs infuscated. Legs with the coxæ and trochanters pale yellow; femora and tibiæ pale brown; tarsi brownish black. Wings (Plate 1, fig. 18) subhyaline, the short-oval stigma pale brown; veins dark brown. Venation: $Sc_1$ ending opposite origin of Rs, $Sc_2$ far back from its tip, $Sc_1$ exceeding Rs in length; free tip of $Sc_2$ lying just proximad of $R_2$; cell 1st $M_2$ open by the atrophy of m; $M_{3+4}$ longer than vein $M_4$; m-cu at or shortly before fork of M.

Abdominal tergites brown, the sternites obscure yellow, the incisures very vaguely and narrowly more darkened. Male hypopygium (Plate 4, fig. 48) with the tergite, *9t,* deeply emarginate, the lobes with numerous setæ. Basistyle, *b,* with the ventromesal lobe long and conspicuous, densely setiferous. Ventral dististyle, *vd,* large and fleshy, the rostral prolongation with three subequal spines near base, these placed rather close together, not from enlarged basal tubercles. Ovipositor with the cerci very slender, upcurved.

*Habitat.*—Kashmir.

Holotype, male, Doku, Baltistan, altitude 10,000 feet, September 9, 1934 (*Hutchinson*). Allotopotype, female. Paratopotype, female; paratype, male, Skardu, altitude 7,000 feet, September 10, 1934 (*Hutchinson*).

*Limonia* (*Dicranomyia*) *tricuspidata* is most nearly related to *L.* (*D.*) *immodestoides* (Alexander), widely distributed in eastern Asia, differing especially in the somewhat longer vein Sc, and in the structure of the male hypopygium, as the elongate ventromesal lobe of the basistyle and the trispinous prolongation of the ventral dististyle. *Limonia* (*D.*) *patens* (Lundström), of northern Europe and eastern Siberia, is likewise a member of this group, yet very different from the two species abovementioned. *Limonia* (*D.*) *absens* (Brunetti), of the eastern Himalayas, differs in the coloration of the body and legs and in the more elongate cell $M_3$ of the wings, this being nearly twice as long as its petiole. This latter species is still known only from the female sex.

### LIMONIA (DICRANOMYIA) BIFUSIFERA (Edwards).

*Dicranomyia bifusifera* EDWARDS, Ann. & Mag. Nat. Hist. IX 20 (1927) 225–226.

Described from a unique male taken in Kashmir, without exact locality, altitude 11,000 to 13,000 feet, collected by Mitchell. Five males, Pulwar Nullah, Kashmir, altitude 11,000 feet, October 8, 1934 (*Hutchinson*).

These specimens differ somewhat from Edwards's description in the details of coloration and venation, but the peculiar hypopygium is identical, and I have little doubt of the determination. General coloration of the entire thorax dark gray. Legs brown to brownish black, the femoral bases brighter. Wings with $Sc_1$ much shorter than Rs, somewhat variable in the present series, ranging from one-third to one-fifth the length of Rs.

### ANTOCHA (ANTOCHA) PICTURATA sp. nov. Plate 1, fig. 19.

Mesonotal præscutum reddish, with a gray pruinosity; a median brown stripe on præscutum; halteres and legs pale; wings milky white, with a handsome, pale gray, clouded pattern, including clouds in cells R, M, and $R_3$; vein $R_2$ in transverse alignment with r-m; cell 1st $M_2$ relatively small; m-cu shortly before fork of M.

*Female*.—Length, 5 to 5.5 millimeters; wing, 4.5 to 5.

Rostrum and palpi brownish black. Antennæ black, the pedicel a little paler; flagellar segments short-oval. Head dark gray.

Mesonotal præscutum reddish, with a gray pruinosity; a median brown stripe on præscutum, becoming obsolete before the suture; posterior sclerites of notum gray, the scutellum paler. Pleura chiefly brownish yellow. Halteres pale. Legs with the coxæ and trochanters yellow; remainder of legs chiefly yellow, only the terminal tarsal segments more darkened. Wings (Plate 1, fig. 19) milky white, with a handsome, pale gray, clouded pattern, including the stigma, cord, outer end of cell 1st $M_2$, all of vein 2d A, and distal third of 1st A; clouds in cells R and M opposite the origin of Rs, and near the outer end of cell $R_3$; veins pale, darker brown in the clouded areas. Venation: $R_2$ in transverse alignment with r-m; cell 1st $M_2$ relatively small, the second section of vein $M_{1+2}$ shorter than the last section; m-cu shortly before the fork of M.

Abdomen pale brown to brownish yellow, the posterior borders of the segments restrictedly paler.

*Habitat.*—China (Szechwan).

Holotype, Gehang, October 5, 1934 (*Franck*). Paratopotype, female.

The handsomely patterned wings readily separate the present fly from all regional species, excepting *Antocha* (*Antocha*) *bifida* Alexander, *A.* (*A.*) *nebulosa* Edwards, and *A.* (*A.*) *nebulipennis* Alexander. The more-involved and complicated wing pattern and the uniformly pale yellow legs readily distinguish the present fly.

**ORIMARGA (ORIMARGA) BASALIS** sp. nov. Plate 1, fig. 20.

General coloration gray; rostrum and base of scape reddish; halteres whitish throughout; femora pale brown, with a slightly indicated, darker brown, subterminal ring; wings pale yellow, veins yellow, Cu and 2d A darker; $R_{2+3}$ elongate, subequal to Rs; m-cu lying unusually far basad, opposite origin of Rs.

*Male.*—Length, about 7 millimeters; wing, 6.5.

*Female.*—Length, about 7.5 to 8 millimeters; wing, 6.3 to 7.

Rostrum reddish; palpi a little darker. Antennæ with basal portion of scape reddish, the remainder of organ black; flagellar segments oval, the outer ones a trifle more elongate, with short verticils. Head gray, slightly more brownish gray behind.

Mesonotum gray, in cases with the præscutum having indistinct more brownish lines on the interspaces. Pleura more or less pruinose, especially the dorsal portion, the ventral region paler and, in cases, more reddish. Halteres whitish throughout. Legs with the coxæ and trochanters pale; femora pale brown or yellowish brown, becoming narrowly darker just before the pale tips; in cases, the femora are more evenly and generally darkened; tibiæ and tarsi darker brown. Wings (Plate 1, fig. 20) almost uniformly pale yellow, the prearcular field whitened; axillary region narrowly darkened; veins yellow, Cu, 2d A, and basal portion of 1st A darker. Macrotrichia of veins beyond cord abundant, there being a series of more than thirty on vein $R_3$. Venation: Sc relatively long, $Sc_1$ ending a short distance before fork of Rs, $Sc_2$ near its tip; $R_{2+3}$ elongate, subequal to or only a little shorter than Rs and exceeding twice $R_{1+2}$ alone; basal section of $R_{4+5}$ long, exceeding $R_{1+2}$; r-m lying a short distance basad of $R_2$; m-cu lying unusually far basad, opposite the extreme basal portion of Rs.

Abdominal tergites dark brown, the sternites a trifle paler, more yellowish brown.

*Habitat.*—Kashmir.

Holotype, male, Skardu, altitude 7,000 feet, July 12, 1934, in marshy area, associated with *Gonomyia* (*Ptilostena*) *reticulata* Alexander (*Hutchinson*). Allotopotype, female. Paratopotypes, males and females, altitude 7,000 to 7,700 feet, July 3 to 12, 1934 (*Hutchinson*).

All species of *Orimarga* hitherto made known from British India and the Himalayas have vein $R_{2+3}$ short, less than one-third the length of Rs. The present fly is most closely allied to certain species from Japan and western China, such as *Orimarga* (*Orimarga*) *formosicola* Alexander, *O.* (*O.*) *omeina* Alexander, *O.* (*O.*) *pruinosa* Alexander, and *O.* (*O.*) *yakushimana* Alexander, differing from all in the pattern of the femora and the position of m-cu opposite the extreme base of Rs, thus making the second section of vein M of unusual length.

## HEXATOMINI

**PSEUDOLIMNOPHILA APICINIGRA** sp. nov. Plate 1, fig. 21.

General coloration of head and thorax gray; antennæ with scape dark brown, the pedicel a little paler; basal segment of flagellum obscure brownish yellow; outer flagellar segments cylindrical, with long conspicuous verticils that much exceed the segments in length; præscutum with two intermediate darker gray stripes that are separated by a capillary brown vitta; femora obscure yellow, the tips narrowly blackened; wings yellowish brown, the small stigma pale brown; $R_{1+2}$ longer than the strongly erect $R_{2+3+4}$; $R_{2+3}$ a little shorter than $R_{2+3+4}$; cell $M_1$ about twice its petiole; m-cu a little proximad of r-m; anterior arculus preserved; abdominal tergites dark brown, the sternites yellowish.

*Male.*—Length, about 8.5 millimeters; wing, 8.

*Female.*—Length, about 9 to 10 millimeters; wing, 8.5 to 9.

Rostrum and palpi dark brown. Antennæ with the scape dark brown; pedicel a little paler; basal segment of flagellum obscure brownish yellow to brown; remaining segments passing into black; outer flagellar segments cylindrical, with long conspicuous verticils that much exceed the segments in length. Head gray; anterior vertex wider than the diameter of scape.

Mesonotal præscutum gray, with indications of two darker gray submedian stripes and more brownish lateral stripes; intermediate stripes separated by a capillary brown vitta; pseudosutural foveæ and tuberculate pits black; posterior sclerites of notum gray. Pleura gray. Halteres pale, the knobs weakly infumed. Legs with the coxæ and trochanters pale yellow; femora obscure yellow, the tips narrowly but conspicuously blackened, the amount subequal on all legs; tibiæ light brown, the tips very narrowly infuscated; basitarsi brown, the tips brownish black; outer tarsal segments black. Wings (Plate 1, fig. 21) with a strong yellowish brown tinge, the costal and prearcular regions, together with cell $Cu_1$, somewhat more yellowish; stigma very small and pale, scarcely differentiated; veins brown. Macrotrichia of veins abundant and of moderate length. Venation: $Sc_1$ ending nearly opposite fork of Rs, $Sc_2$ a short distance from its tip; $R_1$ incrassated opposite $R_2$; $R_{1+2}$ longer than the strongly erect $R_{2+3+4}$; $R_{2+3}$ a little shorter than $R_{2+3+4}$; cell $M_1$ about twice its petiole; m-cu lying a little proximad of r-m, not far beyond fork of M; anterior arculus preserved.

Abdominal tergites dark brown; sternites yellowish.

*Habitat.*—Kashmir.

Holotype, male, Skardu, altitude 7,700 feet, July 3, 1934 (*Hutchinson*). Allotopotype, female. Paratopotype, female.

In the suberect vein $R_{2+3+4}$ the present fly is rather similar to the Japanese *Pseudolimnophila erecta* Alexander, an otherwise very different species, having $R_{1+2}$ short and m-cu beyond midlength of cell 1st $M_2$. The Indian species that are most closely allied are *P. fusca* (Brunetti) and *P. pallidicoxa* (Brunetti), from both of which the present fly is readily told by the gray coloration of the head and thorax, the uniformly pale abdominal sternites, and the black-tipped femora. As indicated by Edwards[4] the species *pallidicoxa* was evidently founded on a mixture of two genera and the identity of the holotype specimen is in doubt. A paratype in my collection, which seems to agree well with Brunetti's conception of the species in 1912, when the insect was described (but not in 1918, when Brunetti keyed the Oriental species of the group and gave a figure of *pallidicoxa* as he then construed the species) is evidently allied to the present fly, but differs venationally in the longer and less erect $R_{2+3+4}$ and the smaller cell 1st $M_2$.

**HEXATOMA (ERIOCERA) LUXURIOSA** sp. nov. Plate 1, fig. 22.

Belongs to the *nepalensis* group; mesonotal præscutum in front fiery orange, scutum and parascutella brownish black, mediotergite dull yellow; pleura uniformly dark liver brown; antennæ and legs dark brown; wings dark brown, the anal cells paler; a conspicuous white discal area before the cord; $R_2$ transverse, $R_{1+2}$ subequal to $R_{2+3}$; cell $M_1$ lacking; m-cu near outer end of cell 1st $M_2$; abdomen black, the basal rings of segments two to six (female) and two to seven (male) polished nacreous; genital segment of female orange; male hypopygium black; subterminal segments in male expanded into a weak spatula.

*Male.*—Length, about 15 millimeters; wing, 15.

*Female.*—Length, about 18 millimeters; wing, 13.

Rostrum black; palpi brownish black. Antennæ brownish black throughout. Head dull black; vertical tubercle small, with a lower, less evident tubercle immediately in front of it.

Prothorax dark liver brown. Mesonotal præscutum in front and on sides deep fiery orange, becoming more infuscated behind; scutum and parascutella dark brown or brownish black; scutellum obscure orange; mediotergite dull yellow, unmarked. Pleura and pleurotergite, including dorsopleural membrane, uniformly dark liver brown, unmarked. Halteres dark brown. Legs dark brown throughout, femoral bases unbrightened. Wings (Plate 1, fig. 22) almost uniformly suffused with dark brown, including the prearcular field and costal region; anal cells paler, except as a seam along vein 2d A; a conspicuous white area before the cord, including cells $R_1$, R, and M, not quite reaching veins $R_1$ and Cu, the distal edge reaching the fork of Rs, a little wider in cells R and M; veins brown, yellow in the white discal band. Macrotrichia of veins beyond cord small and sparse, or lacking. Venation: $Sc_1$ ending shortly before $R_2$, the latter transverse; $R_{1+2}$ subequal to or longer than $R_{2+3}$; cell $M_1$ lacking; m-cu near outer end of cell 1st $M_2$.

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[4] Rec. Indian Mus. 26 (1924) 302.

Abdomen dull black, segments two to six (female) and two to seven (male) with the basal rings polished nacreous; outer segments in male more uniformly dull black; ovipositor and genital segment fiery orange; in male, segments five to seven gently expanded into a weak spatula, hypopygium black.

*Habitat.*—Siam.

Holotype, male, Chieng-mai, October 25, 1920; American Museum of Natural History F 4564; accession No. 22,628. Allotopotype, female, F 4560, in author's collection.

By Edwards's key to the Old World species of *Eriocera*[5] the present fly runs to *Hexatoma* (*Eriocera*) *fenestrata* (Brunetti), which differs in various details of coloration of the thorax and wings. None of the species more recently defined by Edwards and the present writer is more nearly allied to the present insect.

### ERIOPTERINI

#### GONOMYIA (PTILOSTENA) RETICULATA Alexander.

*Gonomyia* (*Ptilostena*) *recticulata* ALEXANDER, Bull. Mus. Hist. Nat. Paris, for 1921 (1921) 305–306.

The unique type and hitherto only known specimen was from the Gobi Desert, Mongolia, altitude 1,000 to 2,000 meters, collected in June, 1909, by Dr. L. Vaillant. Five males and females, Skardu, Kashmir, altitude 7,700 feet, July 3 to 12, 1934, and 7,000 feet, September 9 and 10, 1934 (*Hutchinson*); at light, and swept from a swampy area where it was associated with *Orimarga* (*Orimarga*) *basalis* sp. nov. and *Pseudolimnophila apicinigra* sp. nov.

The type was badly discolored and the following supplementary notes are given:

*Male.*—Length, about 6 millimeters; wing, 6.

*Female.*—Length, 7 to 8 millimeters; wing, 7 to 8.5.

General coloration of thorax gray; præscutum with two intermediate dark brown stripes; humeral region restrictedly yellow; pseudosutural foveæ black, conspicuous; scutal lobes variegated by dark brown spots. Pleura gray, with a broken yellow longitudinal stripe that includes the ventral anepisternum, and, in cases, the metapleura; pteropleurite darkened.

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[5] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

**ERIOPTERA (ERIOPTERA) PALLICLAVATA** sp. nov. Plate 1, fig. 23; Plate 4, fig. 49.

General coloration pale yellow; antennæ, legs, and halteres pale throughout; wings pale yellowish subhyaline, the veins a trifle darker yellow; male hypopygium with the outer dististyle slender, produced into a pale, toothlike lobe at base; gonapophyses appearing as simple darkened blades.

*Male.*—Length, about 6 millimeters; wing, 6.5.

Rostrum pale; palpi black. Antennæ pale throughout. Head pale yellow; eyes (male) of normal size.

Mesonotum uniformly pale yellow to testaceous-yellow; pleura paler yellow. Halteres white throughout. Legs with the coxæ and trochanters pale yellow; remainder of legs yellow, the terminal tarsal segments passing into dark brown. Wings (Plate 1, fig. 23) pale yellowish subhyaline, the veins a trifle darker yellow; macrotrichia light brown. Venation: $Sc_1$ ending just before $R_2$, $Sc_2$, not evident in the unique type; distal end of vein $Cu_1$ deflected suddenly cephalad; vein 2d A very strongly bent at midlength, the outer half paralleling the posterior border of wing.

Abdomen pale brownish yellow, the lateral borders a little darkened. Male hypopygium (Plate 4, fig. 49) with a small subapical lobe on mesal face of basistyle, *b*, near apex. Outer dististyle, *od*, slender, with a pale toothlike extension at base, the apex a trifle enlarged and darkened. Inner dististyle, *id*, strongly twisted at near two-thirds the length, the apex a narrowly darkened spine. Gonapophyses, *g*, appearing as simple darkened blades.

*Habitat.*—Kashmir.

Holotype, male, Minimarg, September 14, 1934 (*Hutchinson*).

By Brunetti's key to the Indian species of *Erioptera*[6] the present fly runs to *Erioptera flava* Brunetti (preoccupied, renamed *bengalensis* Alexander), which belongs to the subgenus *Meterioptera*. The present fly is a true *Erioptera*, apparently most nearly allied to *E.* (*E.*) *xanthoptera* Alexander,[7] of northern Japan. The latter species, still known only from the female sex, is dark brown, with the wings more strongly suffused with yellow. Among the European species, the present fly is most generally similar to *E.* (*E.*) *flavescens* (Linnæus) and *E.* (*E.*) *meijerei* Edwards, differing conspicuously in the structure of the male hypopygium.

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[6] Brit. India, Diptera Nematocera (1912) 448–449.

[7] Philip. Journ. Sci. 24 (1924) 582.

**ORMOSIA SECLUSA** sp. nov. Plate 1, fig. 24; Plate 4, fig. 50.

Mesonotum varying from reddish brown to gray, the pleura gray; halteres pale yellow throughout; wings with a brown tinge, the prearcular and basal costal regions more yellowish; cell $M_2$ open by the atrophy of the basal section of $M_3$; veins $M_3$ and m not angulated at point of union; vein 2d A sinuous on outer third; male hypopygium with the gonapophyses appearing as long slender black spines, each with two or three smaller spines near tip and with a long slender spine on outer face at near midlength.

*Male.*—Length, about 4 to 4.3 millimeters; wing, 5 to 5.5.

*Female.*—Length, about 5.5 millimeters; wing, 6.

Rostrum and palpi black. Antennæ brownish black, of moderate length in male, if bent backward ending before wing root. Head dark gray.

Pronotum and mesonotum varying in color in different specimens, in some grayish brown to darker gray, in others more reddish brown; humeral triangle restrictedly brightened. Pleura brownish gray. Halteres pale yellow throughout. Legs with the coxæ dark reddish brown; trochanters obscure yellow; femora yellow basally, passing into yellowish brown; tibiæ obscure yellow, the tarsi passing into dark brown. Wings (Plate 1, fig. 24) with a brown tinge, the prearcular and basal costal regions more yellowish; stigmal region slightly darker brown; veins stout, pale brown, indistinctly seamed with brown. Venation: $R_{2+3+4}$ and $R_{2+3}$ subequal, a trifle exceeding $R_2$ alone; cell $M_2$ open by atrophy of basal section of $M_3$; m and outer section of $M_3$ not angulated at point of union; m-cu at or just before fork of M; vein 2d A sinuous on outer third.

Abdomen dark brown, the hypopygium a little brighter. Male hypopygium (Plate 4, fig. 50) with the ninth tergite, *9t*, relatively narrow. Basistyle, *b*, not produced. Outer dististyle, *od*, a small, earlike structure, set with abundant appressed microscopic setulæ. Inner dististyle, *id*, with the apex narrowed into a slender curved sclerotized arm, the notch filled with pale membrane. Gonapophyses, *g*, appearing as long slender black spines, each with two or three smaller appressed spines on outer margin back from tip, and a longer slender black spine more basal in position at near midlength of the outer face of the apophysis.

*Habitat.*—Japan (Honshiu).

Holotype, male, Konseitoge, Shimotsuke, altitude 7,000 feet, August 6, 1934 (*Issiki*). Allotype, female, pinned with type. Paratopotypes, 3 males and females.

The structure of the male hypopygium, and especially of the peculiarly formed gonapophyses, is very different from that of all allied regional species of *Ormosia,* such as *O. takahashii* Alexander and *O. takeuchii* Alexander.

# ILLUSTRATIONS

[*a*, Ædeagus; *b*, basistyle; *c*, cercus; *d*, dististyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

## PLATE 1

FIG. 1. *Trichocera alticola* sp. nov., venation.
2. *Trichocera glacialis* sp. nov., venation.
3. *Trichocera abieticola* sp. nov., venation.
4. *Ctenacroscelis nimbus* sp. nov., venation.
5. *Tipula* (*Sinotipula*) *hutchinsonæ* sp. nov., venation.
6. *Tipula* (*Acutipula*) *irrequieta* sp. nov., venation.
7. *Tipula* (*Oreomyza*) *baltistanica* sp. nov., venation.
8. *Tipula* (*Oreomyza*) *venerabilis* sp. nov., venation.
9. *Tipula* (*Oreomyza*) *icarus* sp. nov., venation.
10. *Tipula* (*Lunatipula*) *hypovalvata* sp. nov., venation.
11. *Tipula xanthocera* sp. nov., venation.
12. *Nephrotoma inconsequens* sp. nov., venation.
13. *Nephrotoma parascutellata* sp. nov., venation.
14. *Nephrotoma meraca* sp. nov., venation.
15. *Nephrotoma trilobulata* sp. nov., venation.
16. *Nephrotoma irrevocata* sp. nov., venation.
17. *Limonia* (*Limonia*) *protrusa* sp. nov., venation.
18. *Limonia* (*Dicranomyia*) *tricuspidata* sp. nov., venation.
19. *Antocha* (*Antocha*) *picturata* sp. nov., venation.
20. *Orimarga* (*Orimarga*) *basalis* sp. nov., venation.
21. *Pseudolimnophila apicinigra* sp. nov., venation.
22. *Hexatoma* (*Eriocera*) *luxuriosa* sp. nov., venation.
23. *Erioptera* (*Erioptera*) *palliclavata* sp. nov., venation.
24. *Ormosia seclusa* sp. nov., venation.

## PLATE 2

FIG. 25. *Trichocera alticola* sp. nov., ovipositor, cercus, lateral.
26. *Trichocera glacialis* sp. nov., male hypopygium.
27. *Trichocera abieticola* sp. nov., male hypopygium.
28. *Ctenacroscelis nimbus* sp. nov., male hypopygium, details.
29. *Tipula* (*Sinotipula*) *hutchinsonæ* sp. nov., male hypopygium.
30. *Tipula* (*Sinotipula*) *hutchinsonæ* sp. nov., male hypopygium, details.
31. *Tipula* (*Acutipula*) *irrequieta* sp. nov., male hypopygium.
32. *Tipula* (*Oreomyza*) *baltistanica* sp. nov., male hypopygium.
33. *Tipula* (*Oreomyza*) *baltistanica* sp. nov., male hypopygium, styli.

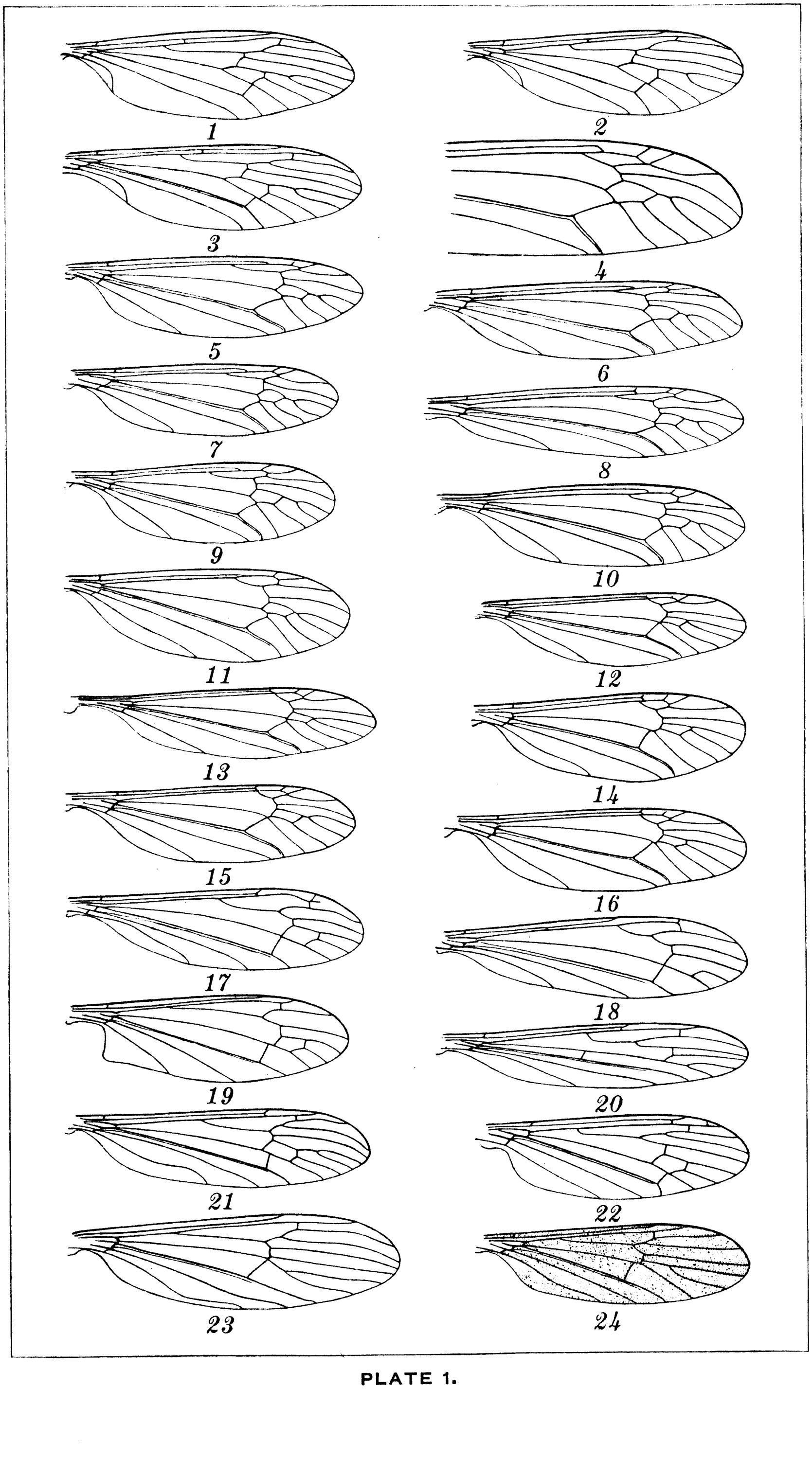
## PLATE 3

FIG. 34. *Tipula* (*Oreomyza*) *venerabilis* sp. nov., male hypopygium, details.
35. *Tipula* (*Oreomyza*) *icarus* sp. nov., male hypopygium.

FIG. 36. *Tipula* (*Oreomyza*) *icarus* sp. nov., male hypopygium, details.
37. *Tipula* (*Lunatipula*) *submarmoratipennis* sp. nov., male hypopygium, details.
38. *Tipula* (*Lunatipula*) *submarmoratipennis* sp. nov., male hypopygium, details.
39. *Tipula* (*Lunatipula*) *hypovalvata* sp. nov., male hypopygium.
40. *Tipula* (*Lunatipula*) *hypovalvata* sp. nov., male hypopygium, details.
41. *Tipula xanthocera* sp. nov., male hypopygium, details.
42. *Tipula xanthocera* sp. nov., male hypopygium, details.

### PLATE 4

FIG. 43. *Nephrotoma inconsequens* sp. nov., male hypopygium, details.
44. *Nephrotoma parascutellata* sp. nov., male hypopygium, details.
45. *Nephrotoma meraca* sp. nov., male hypopygium, details.
46. *Nephrotoma trilobulata* sp. nov., male hypopygium, details.
47. *Nephrotoma irrevocata* sp. nov., male hypopygium, details.
48. *Limonia* (*Dicranomyia*) *tricuspidata* sp. nov., male hypopygium.
49. *Erioptera* (*Erioptera*) *palliclavata* sp. nov., male hypopygium.
50. *Ormosia seclusa* sp. nov., male hypopygium.



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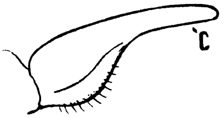

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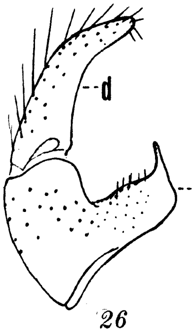

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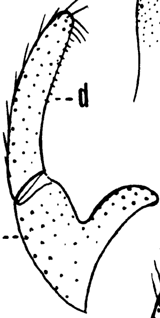

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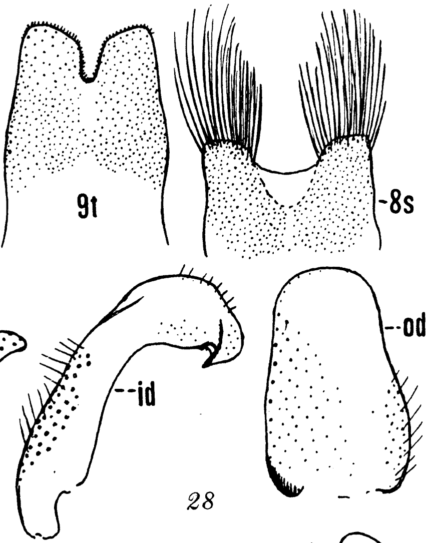

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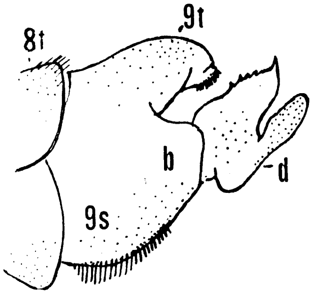

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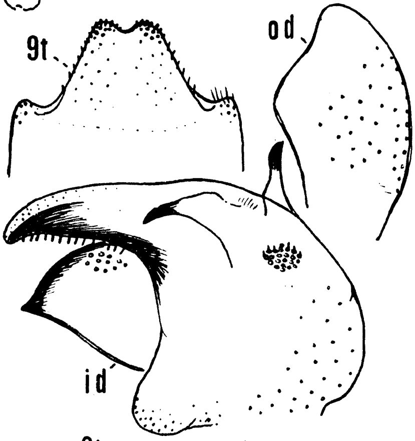

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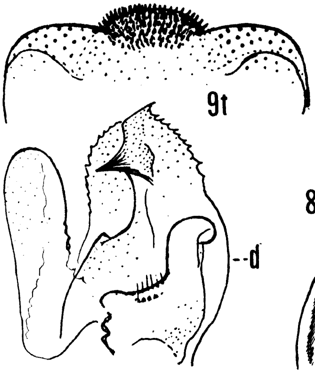

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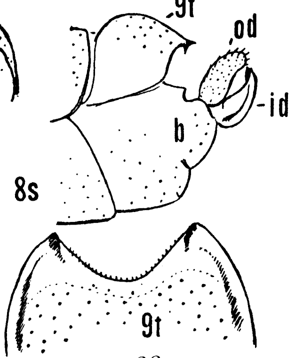

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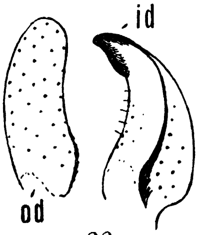

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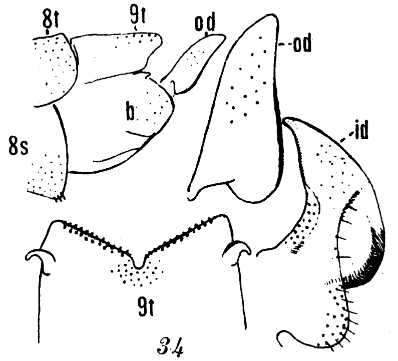

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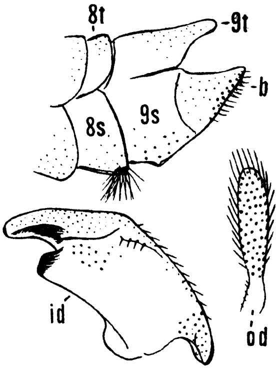

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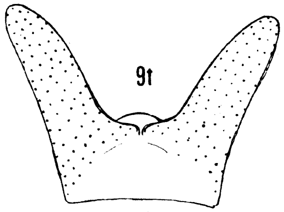

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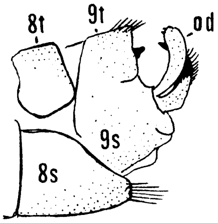

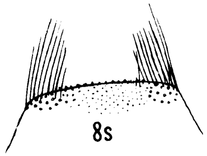

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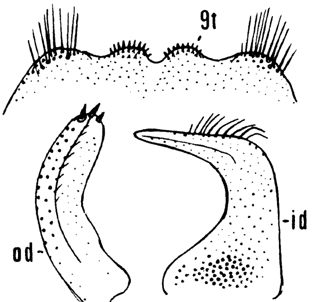

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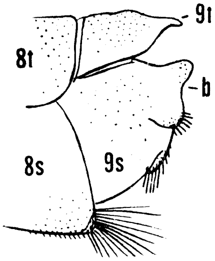

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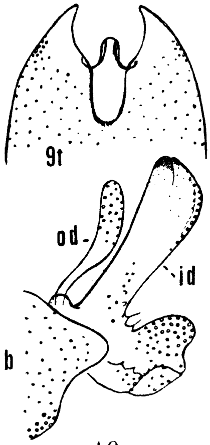

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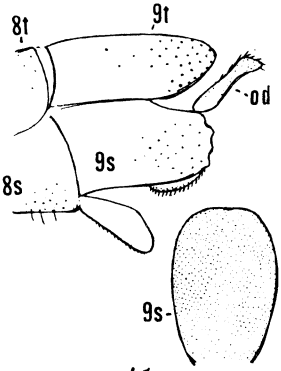

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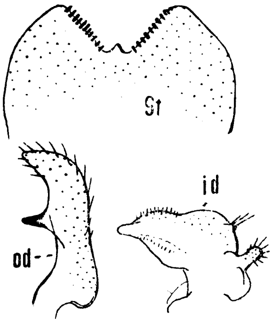

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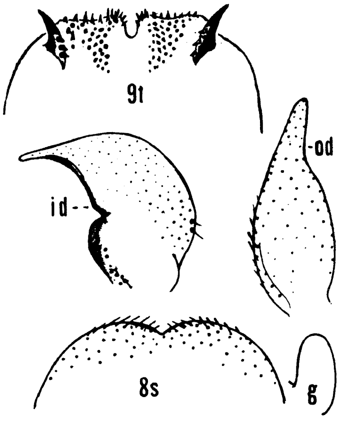

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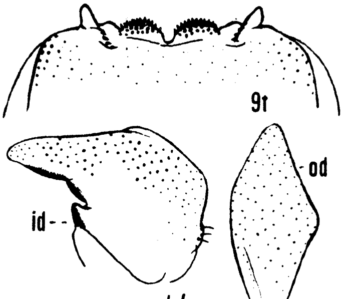

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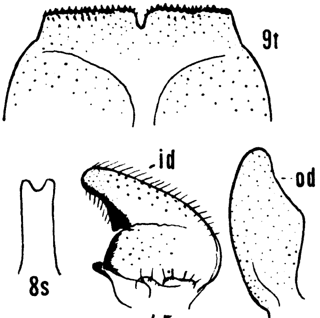

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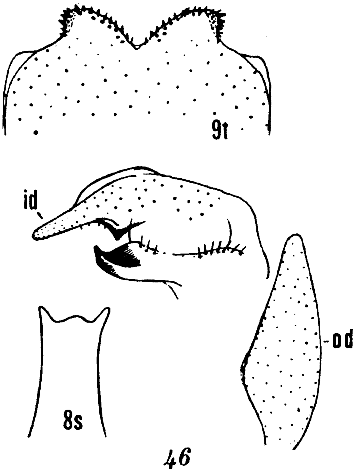

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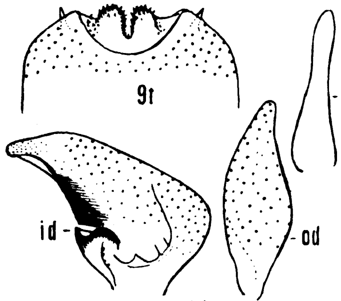

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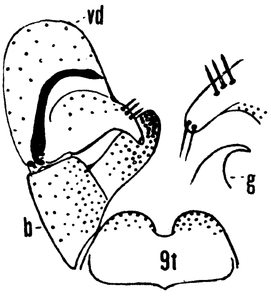

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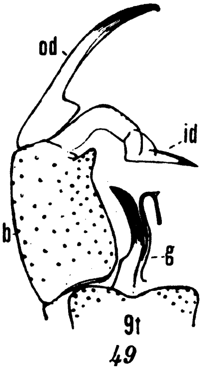

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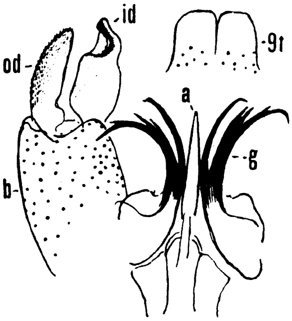

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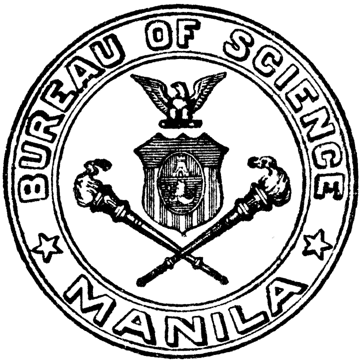

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# THE VITAMIN CONTENTS OF PHILIPPINE FOODS, IV

## VITAMINS A AND $B_1$ IN VARIOUS FRUITS AND VEGETABLES

By A. J. HERMANO and P. J. AGUILA
*Of the Bureau of Science, Manila*

This paper is a continuation of our work on the vitamin contents of Philippine vegetables, fruits, and other products. Three papers[1] have already appeared and this makes our fourth report.

Previous work on the vitamin contents of some Philippine edible products has also been carried out by various other investigators.[2]

In the Philippines the diet of the masses consists largely of polished rice, which is deficient in vitamin $B_1$. As vegetables and fruits, more or less, are also included in the diet, a knowledge of the vitamin contents of these products is of considerable importance, for such information is helpful in correcting deficiencies in the diet.

### MATERIALS

The materials used in this investigation consisted of various Philippine fruits and vegetables. Most of them were purchased in the public markets of Manila, though some were obtained from the provinces. Fourteen samples were tested for the vitamin A content and ten were examined for vitamin $B_1$. The products tested were as follows:

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[1] Hermano, A. J., Philip. Journ. Sci. **41** (1930) 387. Hermano, A. J., and G. Sepulveda, jr., Philip. Journ. Sci. **53** (1934) 379; **54** (1934) 61.

[2] Jesus, Francisco de, Philip. Agr. **5** (1917) 533. Santos, F. O., Am. Journ. Physiol. **59** (1922) 310. Acuña, E. M., Philip. Agr. **12** (1923) 293. Santos, F. O., and S. Santos, Philip. Journ. Sci. **30** (1926) 307. Santos, F. O., and E. G. Collado, Philip. Agr. **16** (1928) 513. Sherman, Hartley Embrey, Philip. Journ. Sci. **38** (1929) 1, 9. Hermano, A. J., Philip. Journ. Sci. **41** (1930) 387. Lara, C. B., and Manuel Nicolas, Philip. Is. Med. Assoc. Journ. **10** (1930) 263.

**ACHRAS ZAPOTA Linn.; local names, chico and siku.**

The chico is one of the most palatable of Philippine fruits. It is somewhat spherical and oblong in shape and rather brown in color. The soft juicy flesh has a sweet and characteristic odor and flavor, although in some fruits the flesh is rather gritty or sandy.

**ARTOCARPUS CHAMPEDEN (Lour.) Spreng.; local name, lemosa.**

The lemosa is a fruit that has a flavor somewhat similar to that of jack fruit. It contains many seeds. The edible flesh has a yellow color and an exceedingly sweet aromatic taste and odor.

**BRASSICA CHINENSIS Linn.; local name, pechai.**

Pechai is a vegetable that is grown rather extensively. The succulent leaves and tops are eaten like spinach. Locally it is cooked alone or boiled with other vegetables and meat.

**CERATOPTERIS THALLICTROIDES (Linn.) Brongn.**

This is an edible fern the leaves and tops of which may be used as a leafy vegetable, as "greens," or for salads.

**CORCHORUS OLITORIUS Linn.; local names, saluyot, tagabang, lamhay, and pasau-na haba.**

Saluyot is an annual herb with pointed, toothed leaves, and small yellow flowers. It is extensively used in the northern part of the Philippines. The tender leaves and tops are boiled and eaten as vegetables.

**CUCURBITA MAXIMA Duchesne; local names, calabaza, and kalabasa-napula.**

Squash is an herbaceous annual plant that is tendril-climbing. The large fruits, flowers, tender leaves, and tops are edible. The tender leaves and tops are boiled and eaten as vegetables.

**IPOMOEA BATATAS (Linn.) Poir.; local name, kamote.**

Kamote is a perennial, creeping herbaceous vine. A resinous latex flows when the vine and stem are cut. The fleshy roots, which are edible, occur in various shapes, sizes, and colors. They contain about 20 per cent starch. The leaves and tops are boiled and eaten as vegetables or as salad.

**IPOMOEA REPTANS (Linn.) Poir.; local names, kangkong and tangkong.**

Kangkong is a trailing vine that grows in swampy land and in shallow, stagnant water. It is usually not cultivated but grows wild. It is frequently sold in the local markets. The tender leaves and tops are boiled and eaten as vegetables or as salad.

**MANGIFERA INDICA Linn.; local name, mangang-kalabau.**

The mango grows on a tree that is medium to rather large in size. The ripe fruits are yellow and of different sizes. The fruit has a large seed that is covered with a sweet, juicy pulp. The variety known as "mangang-kalabau" was used in these experiments.

**MUSA SAPIENTUM Linn. var. LACATAN (Blanco) Teodoro; local name, saguing na lakatan.**

The lakatan is one of the best varieties of bananas grown in the Philippines.

**PSOPHOCARPUS TETRAGONOLOBUS (Linn.) DC.; local names, cigarillas, segadilla, and kalamismis.**

The segadilla is a perennial vine twining usually on a fence or bamboo used for support. The tender winged pods are boiled and eaten as vegetables or they may be eaten as salad.

**SANDORICUM KOETJAPE (Burm. f.) Merr.; local names, santol and santor.**

The santol is a medium-sized tree. The fruit is rather round but somewhat flat at the top and bottom. It is light brown in color and contains a juicy pulp. There are both sweet and sour varieties with characteristic flavor. It is an excellent fruit for making jelly.

**ZEA MAYS Linn.; local names, maize and kamais.**

The local varieties of corn are mostly white or yellow. In some provinces the people use corn in addition to rice as the staple diet.

**ANONA MURICATA Linn.; local names, guanabano and guayabano.**

Guayabano is a small tree that has rather large oblong fruits. These fruits have a green color and soft spines. The ripe fruit has white juicy flesh that is fibrous and has a characteristic flavor.

**BRASSICA INTEGRIFOLIA (West.) O. E. Schulz; local name, mostaza.**

Mustard is an herbaceous annual plant. It is cultivated for its leaves which are boiled and eaten as a green vegetable.

**SOLANUM MELONGENA Linn.; local name, talong.**

The eggplant is an herbaceous annual plant that is cultivated extensively in the Philippines. The fruits vary in shape from rather round to oblong or cylindrical. It is one of the commonest vegetables sold in the local markets.

## EXPERIMENTAL PROCEDURE

As in our previous experiments we used the general methods for the biological anlysis of foods. The basal ration in the vitamin A test was modified in that a standard brand of irradiated yeast was used instead of the tikitiki extract formerly employed. Most of the samples were dried in an electric oven controlled at 80° C. They were then powdered and mixed uniformly with the basal ration.

A group of albino rats, weighing about 40 grams each, were given ad libitum a basal ration deficient in vitamin A, and another group was given a basal ration deficient in vitamin $B_1$. When the animals showed definite symptoms of xerophthalmia (vitamin A deficiency) or beriberi (vitamin $B_1$ deficiency) the deficient basal rations were supplemented with portions of the samples to be tested. Powdered samples were added in sufficient amount to make the altered basal ration contain 10 per cent of the powdered sample, though in one case the basal ration contained 15 per cent.

Some test animals were given daily a definite quantity (2 grams) of fresh fruit as a supplement to the deficiency in the basal ration. In experiments with guanabano 2 cubic centimeters of the strained pulp and juice were fed daily to each rat.

The time required to effect a cure for vitamin deficiency was usually about 28 days. During this period the symptoms for vitamin deficiency gradually disappeared and finally the rats appeared to be normal again.

The results of our experiments are recorded in Tables 1 and 2.

## SUMMARY

A number of Philippine fruits and vegetables were tested biologically for their vitamin (A and $B_1$) contents. The results showed that these products vary in their biological value as sources of vitamins.

In testing for vitamin A the rats fed with kangkong, as a supplement to the basal ration, gave the greatest average daily gain in weight (4.03 grams).

Other samples that gave satisfactory results and appeared to be good sources of vitamin A were lemosa fruit, the leaves of pechai, fern, saluyot, squash, and sweet potato, pods of segadilla, and corn. Rats fed with these products gained 2 to 3 grams daily.

When fed with frozen mango the rats had an average daily gain in weight of 1.88 grams. This would indicate that vitamin A in mangos is not greatly affected by freezing.

In general, those materials that had a green or yellow color appeared to be good sources of vitamin A.

Of the samples that were tested biologically for vitamin $B_1$ the tender leaves and tops of the squash gave the best results. The rats gained an average of 3.59 grams daily in weight.

Rats fed with the leaves and tops of mustard, saluyot, and sweet potato, and the fruit of santol gained 2.05 to 2.75 grams daily. These products were, therefore, found to be good sources of vitamin $B_1$.

Only three products were found to be good sources of both vitamins A and $B_1$, and these were the tender leaves and tops of saluyot, squash, and sweet potato.

TABLE 1.—*Results of feeding various fruits and vegetables to albino rats for vitamin A content.*[a]

| Names of fruits and vegetables. | | Parts used. | Amount given. | Average daily gain in weight of rats. | Remarks. |
|---|---|---|---|---|---|
| Scientific. | Common. | | | | |
| | | | | *g.* | |
| *Achras zapota* Linn | Chico, siku | Ripe fruit dried at 80° C. | The basal ration contained 10 per cent of the sample. | 1.55 | Xerophthalmia disappeared and the rats gained in weight gradually and became normal. |
| *Artocarpus champeden* (Lour.) Spreng. | Lemosa | Pulp of the ripe fruit (fresh). | 2 grams daily. | 2.96 | Xerophthalmia was cured. The rats gained in weight and became active. |
| *Brassica chinensis* Linn. | Pechai, selgas, messay. | Tender leaves and tops dried at 80° C. | The basal ration contained 10 per cent of the sample. | 2.00 | The increase in weight and the disappearance of xerophthalmia were gradual. The rats became normal. |
| *Ceratopteris thallictroides* (Linn.) Brongn. | Fern | do | do | 2.35 | Xerophthalmia was cured gradually. The rats gained in weight and became normal. |
| *Corchorus olitorius* Linn. | Saluyot, tagabang, pasau-na-haba. | do | do | 2.18 | The rats gained in weight and became normal. Xerophthalmia disappeared. |
| *Cucurbita maxima* Duchesne | Squash, calabaza, kalabasa. | do | do | 2.64 | The rats gained in weight gradually and xerophthalmia disappeared. The animals became normal. |
| *Ipomoea batatas* (Linn.) Poir. | Kamote | do | do | 2.09 | The rats gained in weight gradually and were cured of xerophthalmia. The animals became normal. |
| Do | Kamote, sweet potato. | Fleshy roots with white contents, dried at 80° C. | do | (b) | The amounts might not have been sufficient to cure xerophthalmia. |
| *Ipomoea reptans* (Linn.) Poir. | Kangkong, tangkong. | Tender leaves and tops dried at 80° C. | do | 4.03 | Rapid increase in weight and disappearance of xerophthalmia were noted. The rats became active and normal. |
| *Mangiferai ndica* Linn. | Mangang-kalabau, mango, pâho. | Frozen pulp of ripe fruit. | 2 grams daily | 1.88 | The rats gained in weight gradually and xerophthalmia disappeared. The rats became active and normal. |

| | | | | | |
|---|---|---|---|---|---|
| *Musa sapientum* Linn. var. *lacatan* (Blanco) Teodoro. | Banana, lakatan | Fresh ripe fruit | do | 1.74 | Xerophthalmia disappeared gradually and the animals gained in weight. The rats became normal. |
| *Psophocarpus tetragonolobus* (Linn.) DC. | Cigarillas, segadilla, kalamismis. | Tender winged pods dried at 80° C. | The basal ration contained 10 per cent of the sample. | 2.38 | The rats gained in weight gradually and xerophthalmia disappeared. The animals became normal. |
| *Sandoricum koetjape* (Burm. f.) Merr. | Santol, santor | Pulp of ripe fruits dried at 80° C. | do | (•) | The three rats showed slow disappearance of xerophthalmia. |
| *Zea mays* Linn | Maize, corn, kamais | Powder of whole dried and matured grain. | do | 2.77 | The rats gained in weight gradually and xerophthalmia disappeared. The animals became normal. |

[a] Each sample was tested with three white rats.

[b] Three rats failed to gain weight.

[c] One rat gained in weight by 0.73 g. The two others failed to gain in weight.

TABLE 2.—*Results of feeding various fruits and vegetables to albino rats for vitamin $B_1$ content.*[a]

| Names of fruits and vegetables. | | Parts of plant used. | Amount fed. | Average daily gain in weight of rats. | Remarks. |
|---|---|---|---|---|---|
| Scientific. | Common. | | | | |
| | | | | *g.* | |
| *Anona muricata* Linn. | Guanabano, guayabano. | Pulp and juice of the ripe fruit (fresh). | 2 cc of the strained pulp and juice daily. | 1.94 | The rats gained in weight gradually, and the symptoms disappeared. The rats became active and normal. |
| *Brassica integrifolia* (West.) O. E. Schulz. | Mustard, mostaza | Tender leaves and tops dried at 80° C. | The basal ration contained 10 per cent of the sample. | 2.18 | The symptoms disappeared and the rats gained in weight rapidly. The animals became active and normal. |
| *Corchorus olitorius* Linn. | Saluyot, tagabang, pasau-na-haba. | do | do | 2.58 | The rats recovered rapidly and gained in weight continually. The animals became active and normal. |
| *Cucurbita maxima* Duchesne. | Squash, calabaza | do | do | 3.59 | The rats recovered from the disease rapidly and gained in weight continually. The animals became active and normal. |
| *Ipomoea batatas* (Linn.) Poir | Kamote, sweet potato, tigsi. | Fleshy root with white contents dried at 80° C. | do | ([b]) | The animals continued to show advanced vitamin $B_1$ deficiency. |
| Do | do | Tender leaves and tops dried at 80° C. | do | 2.75 | Immediate disappearance of the symptoms of vitamin $B_1$ deficiency. The rats gained in weight rapidly and became normal. |
| *Musa sapientum* Linn. var. *lacatan* (Blanco) Teodoro. | Lakatan, bañgaran | Fresh ripe fruit | 2 g of the fruit daily | 1.74 | The symptoms of the vitamin $B_1$ deficiency disappeared gradually. The animals gained in weight and became normal. |
| *Sandoricum coetjape* (Burm.f.) Merr. | Santol, santor | Meat of ripe fruit, dried at 80° C. | The basal ration contained 10 per cent of the sample. | 2.05 | The animals recovered from vitamin $B_1$ deficiency and became normal. |

| | | | | | |
|---|---|---|---|---|---|
| *Solanum melongena* Linn. | Eggplant,[c] talong, tarong. | Immature tender fruit dried at 80° C. | The basal ration contained 15 per cent of the sample. | 1.46 | Gradual disappearance of vitamin $B_1$ deficiency was noted. The animals gained in weight and became normal. |
| *Zea mays* Linn. | Corn (yellow), maize, kamais. | Whole matured grains, powdered. | The basal ration contained 10 per cent of the sample. | 1.65 | The rats gained in weight gradually and the symptoms of vitamin $B_1$ deficiency disappeared. The animals became normal. |

[a] Each sample was tested with three rats except the fleshy root of sweet potato for which six rats were used.

[b] The rats were losing weight.

[c] Three rats died with basal ration containing 10 per cent of the sample.

# TREMATODE PARASITES OF PHILIPPINE VERTEBRATES, VII

## ADDITIONAL RECORDS OF NEW SPECIES

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THREE PLATES

## Family OPISTHORCHIIDÆ Braun, 1901

**OPISTHORCHIS OPHIDIARUM** sp. nov. Plate 1, fig. 1.

A single specimen of this trematode was found in the intestine of a water snake, *Lapemis hardwickii* Gray. The liver of the snake was not examined; if the intestine should prove to be the normal habitat of the parasite, then it is one of the very few exceptions among the members of the genus *Opisthorchis* that occur outside of the bile ducts.

This fluke is the second species of the genus *Opisthorchis* to be reported from the Philippines, the first one being *O. wardi* Wharton, 1921. In the shape of its body it bears a superficial resemblance to *O. anatinus* Yamaguti, 1933, and to *Notaulus asiaticus* Skrjabin, 1913, which, according to Morgan (1927), should be included in the genus *Opisthorchis*. In the possession of cuticular spines it is similar to *O. viverrini* (Poirier, 1886); *O. piscicola* (Odhner, 1902); *O. noverca* Braun, 1903; and *O. pedicellata* Verma, 1927. In the shape of its testes it resembles *O. pedicellata* and *O. anatinus*. It differs, however, from these various species in having a long prepharynx. In the latter respect as well as in the presence of cuticular spines and in the shape and location of its ovary, testes, and excretory bladder, it is very closely related to *Gomtia piscicola* which, according to Thapar (1930), occupies an intermediate position between *Opisthorchis* and *Notaulus*. It may be differentiated from *Gomtia piscicola* by its more elongate shape, the more anterior location of its acetabulum, and the anterior extent of its vitelline glands, which reach to the anterior third of the body length.

*Description.*—Body very elongate, 8.5 millimeters in length by 0.40 millimeter in maximum diameter across ovary. Cuticle armed with minute spines from anterior end to slightly beyond posterior third of body length. Oral sucker moderately developed, subterminal, 0.20 by 0.18 millimeter in size; acetabulum weak, in anterior ninth of body length, 0.10 by 0.11 millimeter in size. Oral sucker separated from pharynx by a prepharynx 0.23 millimeter long; pharynx 0.16 by 0.13 millimeter in size; œsophagus 0.10 millimeter long, bifurcates immediately in front of acetabulum; intestinal cæca reach to near posterior end of body.

Testes oval, postovarial, one immediately behind the other and almost touching, in posterior sixth of body length and confined between intestinal cæca; anterior testis 0.29 by 0.22, posterior testis 0.33 by 0.22 millimeter in size. Seminal vesicle prominently enlarged in diameter and much convoluted; ejaculatory duct unarmed. Common genital opening median, immediately preacetabular.

Ovary globular, to one side of median line, immediately pretesticular, 0.16 millimeter in diameter. Oviduct arises from mediolateral border of ovary; receptaculum seminis small, flask-shaped; Laurer's canal present. Shell gland diffuse, almost median, between ovary and anterior testis. Uterus very long, in transverse coils and mostly confined in space between ovary, intestinal cæca, and acetabulum. Vitelline glands finely granular, not distinctly divided into acini and lying along margins of body from immediately in front of level of ovary to slightly beyond junction of anterior and middle thirds of body length. Eggs typical in appearance; that is, they are operculated and possess a shouldered thickening into which the operculum fits; they measure 30 to 34 by 17 to 19 microns.

Excretory pore posteroterminal; excretory bladder straight, narrow in diameter, dorsal to testes and divides into two branches behind ovary.

*Specific diagnosis.—Opisthorchis:* Body very elongate, 8.5 by 0.40 millimeters in size; cuticle armed. Prepharynx present, 0.23 millimeter long. Acetabulum in anterior ninth of body length. Ovary and testes with smooth borders. Vitelline glands extend from immediately in front of level of ovary to slightly beyond junction of anterior and middle thirds of body length. Excretory bladder a narrow straight tube passing dorsal to testes. Ova 30 to 34 by 17 to 19 microns in size.

*Host.—Lapemis hardwickii* Gray.

*Location.*—Intestine.

*Locality.*—Paombong, Bulacan, Luzon.

*Type specimen.*—Philippine Bureau of Science parasitological collection No. 408.

## Family ECHINOSTOMATIDÆ Looss, 1902

**ECHINOSTOMA CHARADRII sp. nov. Plate 1, figs. 2 and 3.**

This trematode is closely related to *Echinostoma batanguensis* Tubangui, 1932, but differs from it in having sixty-nine collar spines instead of seventy-two.

*Description.*—Body elongate, 6.8 to 8.8 millimeters in length by 2.1 to 2.5 millimeters in maximum diameter across middle of body length. Ventral surface from anterior end to anterior level of acetabulum armed with small spines. Oral sucker small, subterminal, 0.28 to 0.36 by 0.30 to 0.40 millimeter in size; acetabulum large, cup-shaped, 1.0 to 1.2 millimeters from anterior end, 1.3 to 1.6 by 1.0 to 1.6 millimeters in size. Head collar reniform, 1.07 to 1.35 millimeters across, with sixty-nine spines arranged in two alternating rows uninterrupted dorsally. The different groups of collar spines vary in size, the corner spines in some specimens being the larger, and in others some of the dorsal spines; the larger spines measure 125 by 16.5, the smaller ones 66.5 by 25 microns. Mouth ventroterminal; prepharynx absent; pharynx 0.27 to 0.33 by 0.20 to 0.25 millimeter in size; œsophagus 0.20 to 0.43 millimeter long, bifurcates immediately in front of acetabulum; intestinal cæca narrow in diameter, extend to near posterior end of body.

Testes tandem, small, with irregular outline but not lobed, postovarial; anterior testis measures 0.56 to 0.80 by 0.44 to 0.78, posterior testis 0.47 to 0.80 by 0.36 to 0.70 millimeter. Cirrus sac oval, 0.35 to 0.38 by 0.26 to 0.58 millimeter in size, dorsal to acetabulum, barely protruding anteriorly beyond anterior border of latter; incloses seminal vesicle, pars prostatica, and cirrus. Common genital opening median, behind œsophageal bifurcation, covered by acetabulum in ventral view.

Ovary transversely ovoid, median, equatorial or immediately preëquatorial, 0.32 to 0.36 by 0.46 to 0.63 millimeter in size. Shell gland prominent, slightly larger than ovary, between latter and anterior testis. Receptaculum seminis absent, Laurer's canal present. Uterus moderately developed, intercæcal, from ovary to posterior border of acetabulum. Vitellaria follicular, lying on lateral margins of body, from level of posterior border of acetabulum to posterior end of body; follicles of two sides do not intermingle behind second testis. Eggs oval, operculated, thin-shelled, yellowish, 87 to 100 by 54 to 64 microns in size.

Excretory pore posterodorsal; excretory bladder with a terminal secondary bladder, divides into two branches behind second testis.

*Specific diagnosis.—Echinostoma:* Length 6.8 to 8.8, maximum diameter 2.1 to 2.5 millimeters. Cephalic collar 1.07 to 1.35 millimeters in diameter, armed with sixty-nine spines. Testes irregular in outline but not lobed. Eggs 87 to 100 by 54 to 64 microns in size.

*Host.—Pluvialis fulvus.*

*Location.*—Intestine.

*Locality.*—Baao, Camarines Sur, Luzon.

*Type specimens.*—Philippine Bureau of Science parasitological collection No. 324.

**PEGOSOMUM BUBULCUM** sp. nov. Plate 2, fig. 1.

The genus *Pegosomum* von Ratz, 1903, includes three species of flukes; namely, *P. saginatum* (von Ratz, 1898), *P. spiniferum* von Ratz, 1903, and *P. asperum* (Wright, 1879). The original description of *P. asperum* is not available to the writers so that the parasite in question can only be compared with the first two mentioned species. It differs from these in its smaller dimensions and in the posterior extent of its vitelline glands, which do not pass beyond the level of the second testis. In *P. saginatum* and *P. spiniferum,* according to von Ratz (1900) and Odhner (1910), respectively, the vitellaria extend to the posterior end of the body.

*Description.*—Body elongate, tapering towards both extremities more so anteriorly than posteriorly, 5.0 to 6.6 millimeters in length by 1.7 to 2.3 millimeters in maximum breadth across acetabulum or immediately in front of that organ. Entire body surface covered with spines, of which those anterior to the acetabulum are smaller and measure 10.5 to 20.8 by 4.0 to 11.2 microns; those posterior to the acetabulum reach a maximum size of 41.6 by 16.6 microns. Oral sucker weak, 0.14 to 0.15 millimeter across; acetabulum well developed, immediately preequatorial, 0.68 to 0.83 millimeter in diameter. Cephalic collar poorly developed, 0.34 to 0.36 millimeter across, armed with twenty-seven spines arranged in a single row uninterrupted dorsally. Corner collar spines, of which there are four on each side, larger and more or less bunched together, measuring 80 to 83 by 19 microns; lateral collar spines measure 71 to 77 by

19 to 23 and the dorsal spines 50 to 58 by 17 to 19 microns. Pharynx well developed, 0.26 to 0.28 by 0.15 to 0.17 millimeter in size; œsophagus 1.24 to 1.46 millimeters long, bifurcates immediately in front of acetabulum; intestinal cæca simple, slightly wavy in outline, moderately large in diameter, reaching to near posterior end of body.

Testes tandem, postovarial, postequatorial, dissimilar; anterior testis transversely elongate, boat-shaped, 0.38 to 0.41 by 1.18 to 1.52 millimeters in size; posterior testis rounded to ovoid, 0.57 to 0.82 by 0.57 to 1.20 millimeters in size. Cirrus pouch immediately preacetabular, submedian, 0.32 to 0.47 by 0.50 to 0.66 millimeter in size; incloses seminal vesicle, pars prostatica, and cirrus. Common genital pore median, in front of acetabulum, about midway between latter and œsophageal bifurcation.

Ovary small, equatorial, to right side of median line, 0.19 to 0.42 by 0.28 to 0.30 millimeter in size. Shell gland large, median, immediately in front of anterior testis. Uterus short to moderately long, mostly between cæca, anterior testis, and acetabulum. Vitellaria in small granular follicles, from posterior level of pharynx to anterior level of second testis; anteriorly the vitelline glands of both sides meet in the median line, but behind level of œsophageal bifurcation they separate and only occupy lateral margins of body. Transverse vitelline ducts immediately in front of first testis. Ova thin-shelled, yellowish to yellowish brown, operculated, 115.2 to 122.8 by 73 to 76.5 microns in size.

Excretory pore posteroterminal; excretory bladder divides into two branches behind second testis.

*Specific diagnosis.*—*Pegosomum:* Length 5.0 to 6.6, maximum breadth 1.7 to 2.3 millimeters; entire body surface covered with spines. Vitellaria from posterior level of pharynx to anterior level of second testis. Ova 115.2 to 122.8 by 73 to 76.5 microns in size.

*Host.*—*Bubulcus coromandus.*

*Location.*—Liver.

*Locality.*—Baao, Camarines Sur, Luzon.

*Type specimens.*—Philippine Bureau of Science parasitological collection No. 326.

## Family DICROCŒLIIDÆ Odhner, 1911

### PARADISTOMUM EXCALOTES sp. nov. Plate 2, fig. 2.

This is the third species of the genus *Paradistomum* to be described from the Philippines, the others being *P. gregarinum*

(Tubangui, 1928) Tubangui, 1929, and *P. paloensis* Tubangui, 1933. It differs from these two forms in being smaller and in the posterior extent of its cirrus pouch, which reaches the anterior border of the acetabulum. It is more closely related to *P. mutabile* (Molin, 1859), from which it can be differentiated, however, by the shape of its cirrus sac, which is cylindrical; by the position of its genital pore, which is opposite or immediately in front of the œsophageal bifurcation; and by the larger number of its vitelline follicles. In *P. mutabile*, according to Dollfus (1922), the cirrus sac is fusiform, the genital opening is ventral to the pharynx, and the vitellaria are composed on each side of only 10 to 12 large follicles.

*Description.*—Body ovoid, broader posteriorly than anteriorly, 1.1 to 1.8 millimeters in length by 0.44 to 0.80 millimeter in maximum diameter across posterior third of body length. Cuticle smooth. Oral sucker subterminal, 0.15 to 0.20 by 0.14 to 0.21 millimeter in size; acetabulum weak, between anterior and middle thirds of body length, 0.17 to 0.20 millimeter across. Pharynx partly overlapped by oral sucker, 0.070 to 0.075 by 0.055 to 0.060 millimeter in size; œsophagus 0.07 to 0.11 millimeter long; intestinal cæca characteristically wide in diameter, extending to from 0.06 to 0.10 millimeter from posterior end of body.

Testes generally smooth but sometimes with slightly indented margins, oval to subglobular, symmetrical, antovarial, immediately postacetabular, 0.11 to 0.17 by 0.09 to 0.12 millimeter in size. Cirrus sac cylindrical, 0.19 to 0.23 by 0.055 to 0.065 millimeter in size, reaching posteriorly to anterior border of acetabulum; incloses poorly developed seminal vesicle, pars prostatica, and cirrus. Common genital opening median, ventral to œsophageal bifurcation.

Ovary transversely oval, generally smooth but sometimes with slightly indented margins like testes, to one side of median line, immediately behind testes, generally smaller than latter but sometimes almost as large; measures 0.10 to 0.11 by 0.14 to 0.16 millimeter. Shell gland smaller than or as large as ovary, median or submedian; receptaculum seminis and Laurer's canal present. Uterus well developed, occupying most of space not otherwise occupied by other organs behind testes, thus crowding out vitelline glands and obscuring in ventral view the greater lengths of intestinal cæca. Vitellaria consist of moderately numerous follicles and occupy lateral margins of body external to cæca from anterior level of testes to junction between third and last fourth of body length. Transverse vitelline ducts leave vitelline glands at level of ovary. Eggs oval, operculated, thick-shelled, yellowish to dark brown in color, 32.5 to 38.5 by 21 to 23 microns in size.

Excretory pore median, posterodorsal; excretory bladder voluminous, divides into two small branches behind shell gland.

*Specific diagnosis.—Paradistomum:* Length 1.1 to 1.8 millimeters, maximum diameter 0.44 to 0.80 millimeter. Cirrus sac cylindrical, 0.19 to 0.23 by 0.055 to 0.065 millimeter in size; reaches posteriorly to anterior border of acetabulum. Genital pore ventral to œsophageal bifurcation. Vitellaria consist of moderately numerous follicles. Eggs 32.5 to 38.5 by 21 to 23 microns in size.

*Host.—Calotes calotes marmoratus.*

*Location.*—Gall bladder.

*Locality.*—San Juan, Rizal, Luzon.

*Type specimens.*—Philippine Bureau of Science parasitological collection No. 412.

## Family CLINOSTOMIDÆ Luehe, 1901

### EUCLINOSTOMUM MULTICÆCUM sp. nov. Plate 3, fig. 2.

This parasite is the second metacercarial fluke to be reported from the fresh-water fish *Ophiocephalus striatus,* the first one being *Clinostomum dalagi* Tubangui, 1933. It belongs to the genus *Euclinostomum,* the members of which were separated by Travassos (1928) from the old genus *Clinostomum* Leidy, 1856, due to the presence of long cæcal diverticula. It differs from *Euclinostomum heterostomum* (Rudolphi, 1809) in the extent of its uterus which reaches anteriorly only slightly beyond the middle of the body length and not to the posterior border of the acetabulum as in the case of *E. heterostomum.* In that respect it resembles *E. clarias* (Dubois, 1929), a metacercaria found in the body cavity of another fish, *Clarias angolense.* Dubois' original description is not available to the writers, but according to Baer (1933) the genital organs of *E. clarias* are located in the posterior third of the body length, while those of the Philippine species are situated in the middle of the body length.

*Description.*—Body elongate, rounded at both ends, 10.5 to 13.0 millimeters in length by 3.7 to 4.5 millimeters in maximum breadth across middle of body length. Cuticle unarmed. Oral sucker terminal, weak, 0.5 to 0.7 millimeter across. Acetabulum well developed, in middle of anterior third of body length, measures 1.2 to 1.5 by 1.5 millimeters. A very small rudimentary pharynx is present; œsophagus a narrow canal, 0.12 to 0.25 millimeter long. Intestinal cæca prominent, reaching to near posterior end of body, with long external lateral diverticula in postacetabular region; some of the diverticula are forked distally and also reach to near posterior end of body.

Testes tandem, in posterior portion of middle third of body length; anterior testis almost U-shaped, 0.12 to 0.18 by 1.16 to 1.40 millimeters in size; posterior testis crescent-shaped, 0.24 to 0.27 by 0.64 to 0.95 millimeter.

Ovary very small, intertesticular, on right side of median line, 0.15 to 0.16 by 0.17 to 0.20 millimeter in size. Shell gland median, larger than ovary and also between testes. Uterine sac a median longitudinal tube, immediately in front of first testis and extending anteriorly to slightly beyond middle of body length; 1.5 to 1.8 millimeters long. Vitellaria profuse, occupy most of space in postacetabular region not otherwise occupied by other organs.

Excretory pore median, posterodorsal; a pair of prominent lateral excretory vessels lead to excretory pore.

*Specific diagnosis.—Euclinostomum:* Length 10.5 to 13.0, maximum diameter 3.7 to 4.5 millimeters. Intestinal cæca with long diverticula in postacetabular region. Genital organs in middle third of body length; anterior testis U-shaped, posterior testis crescent-shaped.

*Host.—Ophiocephalus striatus.*

*Location.*—Encysted in muscular tissues.

*Locality.*—Baao, Camarines Sur, Luzon.

*Type specimens.*—Philippine Bureau of Science parasitological collection No. 329.

## Family HEMIURIDÆ Luehe, 1901

### ECTENURUS LEMERIENSIS sp. nov. Plate 3, fig. 1.

This parasite is closely related to a group of flukes recently described by Yamaguti (1934) under the genus *Ectenurus* Looss, 1907, from fishes in Japan. It most closely resembles *E. hamati*, from which it may be differentiated by the shape of its testes which are oval to subglobular instead of being wedge-shaped, by the absence of a saccular swelling at the terminal portion of the uterus, and by the greater development of the vitelline glands.

*Description.*—Body elongate, more rounded and broader anteriorly than posteriorly; length 2.5 to 3.2 millimeters, depending upon whether the caudal appendage is extended or retracted;

maximum diameter 0.80 to 0.95 millimeter across anterior level of acetabulum. Tail in extended specimens with a maximum length of 0.42 millimeter. Cuticle unarmed. Oral sucker ventroterminal, 0.24 to 0.28 by 0.25 to 0.31 millimeter in size, with prominent preoral lip; acetabulum very well developed, 0.55 to 0.68 by 0.53 to 0.66 millimeter in size, near middle of body length, its greater bulk in front of equator of body. Prepharynx and œsophagus absent; pharynx 0.13 to 0.15 by 0.12 to 0.15 millimeter in size; intestinal cæca moderately sinuous in outline and swollen in diameter, reaching to near posterior end of tail.

Testes oval to subglobular, one obliquely behind the other and partly overlapping, antovarial and immediately behind acetabulum; anterior testis partly overlapped by acetabulum, 0.20 to 0.29 by 0.18 to 0.22 millimeter and posterior testis 0.18 to 0.33 by 0.27 millimeter in size. Seminal vesicle oval, slightly to one side of median line, at equator of body length and almost entirely overlapped by acetabulum. Pars prostatica median, about halfway between pharynx and acetabulum. Sinus sac (hermaphroditic pouch) pyriform to oval, to one side of median line, immediately behind pharynx, 0.23 to 0.28 by 0.15 to 0.19 millimeter in size. Common genital opening median to submedian, ventral to anterior level of pharynx.

Ovary in posterior third of body length, in contact with second testis, transversely oval to pear-shaped, submedian, 0.11 to 0.16 by 0.15 to 0.22 millimeter in size. Uterus with irregular coils, most of which are found behind acetabulum and the remainder anterior to that organ; the coils do not extend posteriorly beyond level of ovary. Vitellaria well developed, in coiled tubes, of which four pairs could be made out. Eggs small, thin-shelled, operculated, 15 to 17 by 9.6 to 12 microns in size.

*Specific diagnosis.*—*Ectenurus:* Total length 2.5 to 3.2 millimeters, maximum diameter 0.80 to 0.95 millimeter. Testes oval to subglobular, one obliquely behind the other and partly overlapping. Ovary transversely oval to pear-shaped, submedian, in contact with second testis. Vitellaria with four pairs of coiled tubes. Uterus does not extend posteriorly beyond level of ovary. Eggs 15 to 17 by 9.6 to 12 microns in size.

*Host.*—Leather jacket (*Scomberoides* sp.).

*Location.*—Intestine.

*Locality.*—Balayan Bay, Lemery, Batangas, Luzon.

*Type specimens.*—Philippine Bureau of Science parasitological collection No. 419.

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# ILLUSTRATIONS

[Drawings by A. C. Gonzales.]

## PLATE 1

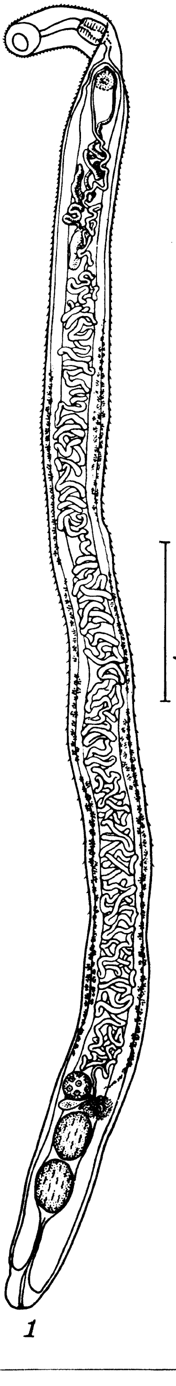
FIG. 1. *Opisthorchis ophidiarum* sp. nov., entire worm, dorsal view.
2. *Echinostoma charadrii* sp. nov., entire worm, ventral view.
3. *Echinostoma charadrii* sp. nov., head collar, ventral view.

## PLATE 2

FIG. 1. *Pegosomum bubulcum* sp. nov., entire worm, ventral view.
2. *Paradistomum excalotes* sp. nov., entire worm, ventral view.

## PLATE 3

FIG. 1. *Ectenurus lemeriensis* sp. nov., entire worm, ventral view.
2. *Euclinostomum multicæcum* sp. nov., entire worm, ventral view.



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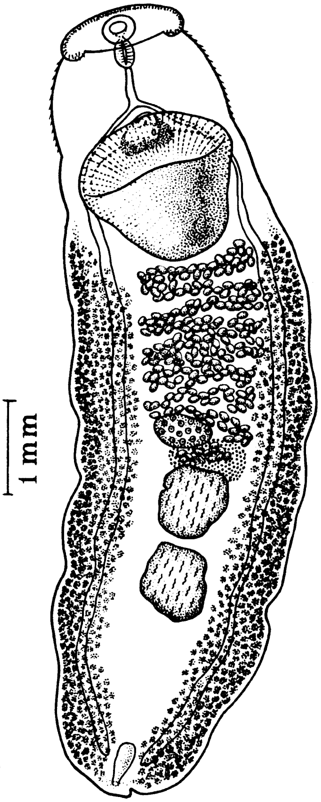

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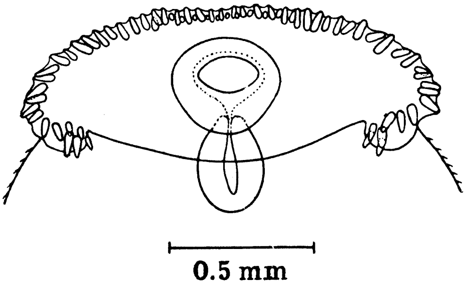

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PLATE 1.

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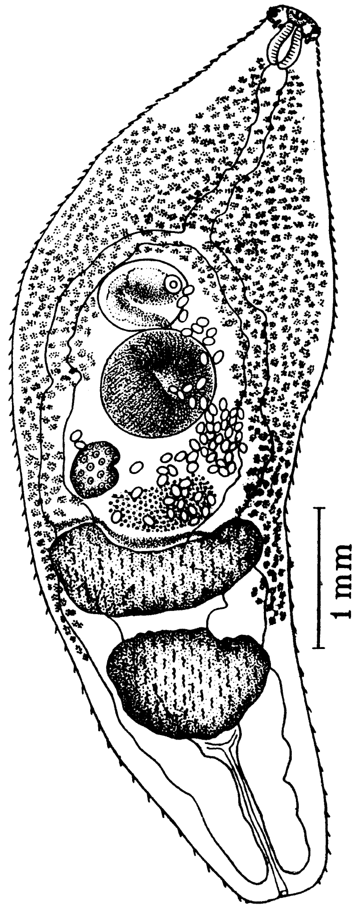

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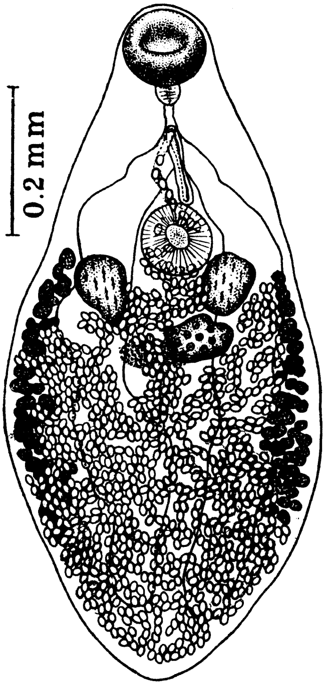

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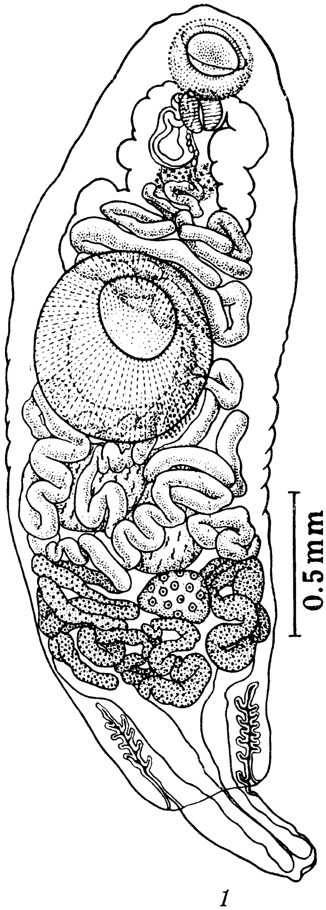
PLATE 2.



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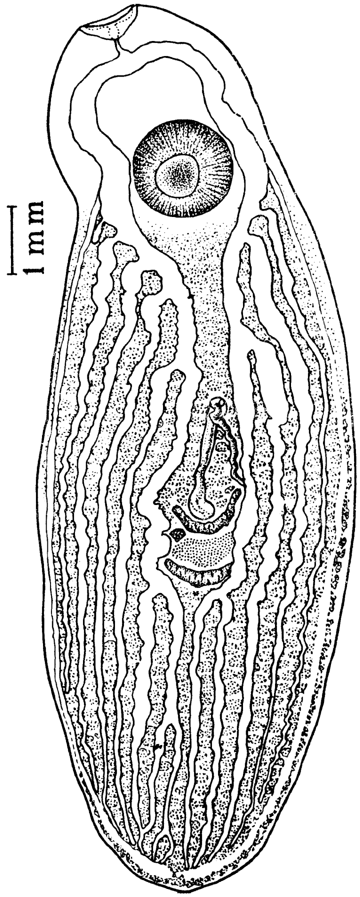

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PLATE 3.

# OBSERVATIONS ON THE GEOGRAPHICAL DISTRIBUTION OF HOOKWORM PARASITES AND HOOKWORM DISEASE IN THE PHILIPPINES[1]

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SEVEN TEXT FIGURES

A question in parasitology that has remained unanswered is the extent to which hookworms are a menace to public health in the Philippines. The large majority of the early workers in medical zoölogy in the Islands expressed the view that the parasites have no local medical importance, due either to the lightness of the infestations (Gomez, 1911), a racial immunity enjoyed by the Filipino people against the effects of the parasites (Schwartz and Tubangui, 1922), or the possible existence in the Philippines of a harmless variety of hookworm (Heiser, 1916).[2] On the other hand Leach, Schwartz, Leach and Haughwout (1923), as well as Manalang (1925), recorded typical cases of hookworm disease in Cebu, where, judging from the reports of these authors, the infestation is a public-health problem.

It occurred to the present writers that these varying opinions on the medical significance of hookworms in the Philippines might be due, as has been found in other parts of the world, to an uneven distribution of the parasites in the Islands, taking for granted that the prevalence or absence of hookworm disease in certain places is due to the existence of favorable conditions for the propagation of the parasites and vice versa. To verify our suspicion it was planned to carry out quantitative hookworm surveys in different parts of the Archipelago.

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[1] Read in part before the Third Philippine Science Convention held in Manila February 26, 1935.

[2] According to Leach, Haughwout and Ash (1923), Manalang (1925) and Tubangui and Francisco (1925) the prevailing species of hookworm in the Philippines is *Necator americanus*.

## PLACES SURVEYED AND TIME OF YEAR

The data presented in this paper are the results of observations that were made during the last four years in the following places: In Palo, Leyte, from January 27 to February 10, 1932; in Manila, from July 25 to September 23, 1932; in Pardo, Cebu, from April 10 to 30, 1933; in Paombong, Bulacan, from May 15 to June 3, 1933; in Cabuyao, Laguna, from October 16 to 21, 1933; in Baao, Camarines Sur, from April 6 to 22, 1934; in Masbate, Masbate, from September 8 to 13, 1934; in Catbalogan, Samar, from September 15 to 18, 1934; in Las Piñas, Rizal, from November 8 to December 5, 1934; and in Cotabato, Cotabato, from April 5 to 11, 1935. These places are very widely separated from one another (text fig. 7) and represent in a marked degree the various conditions of life and environment that are met with in the Islands. For these reasons it was expected that the results of the examinations would yield reliable information on the geographical distribution of hookworm parasites in the Philippines.

## MATERIALS AND METHODS

The total number of persons examined was 2,357, distributed as follows: 169 in Palo, Leyte; 503 in Manila; 489 in Pardo, Cebu; 401 in Paombong, Bulacan; 116 in Cabuyao, Laguna; 220 in Baao, Camarines Sur; 56 in Masbate, Masbate; 34 in Catbalogan, Samar; 315 in Las Piñas, Rizal; and 54 in Cotabato, Cotabato. Those examined in Manila were school children from 7 to 11 years of age, while those examined in the other places represented mixed populations.

The individual fæcal samples were examined according to the modified Stoll egg-counting technic (Stoll and Hausheer, 1926) and in recording the egg counts the figures were brought to the formed basis (Stoll, 1929) and corrected for size according to age (Cort, Otto, and Spindler, 1930). For the isolation of hookworm larvæ from the soil the well-known Baermann apparatus was used, and for measuring the effects of the parasites on the hosts, hæmoglobin determinations with the Tallquist scale were made.

## RESULTS OF EXAMINATIONS

Of the total number of 2,357 persons examined, 1,048, or 44.5 per cent, were found positive for hookworms, the average egg count of the entire series being 1,850 per cubic centimeter of fæces. These figures, however, do not portray accurately the hookworm situation in the Philippines, for which reason the results of the examinations from each of the areas covered by the survey will be discussed separately and then compared with one another. Table 1 gives the incidence of the parasites and the average egg counts arranged according to population groups and analyzed according to age and sex. The age grouping is that suggested by Cort, Riley, Sweet, Schapiro, and Stoll (1929) and is as follows: 0- to 4-year group, representing the youngest children, who are largely confined to the neighborhood of their homes; 5- to 14-year group, which includes the school children and in which there are but little differences in activities between the two sexes; 15- to 49-year group, in which most of the males are engaged in field and other activities and the females in household duties and the rearing of children; 50 + year group, in which both sexes, due to advanced age, tend to be more closely confined to the house.

*Pardo, Cebu.*—Our hookworm egg counts from this locality represent the results of the examination of the same fæcal samples on which our egg counts for ascaris and trichuris from the same town, as described in an earlier paper (Tubangui, Basaca, and Pasco, 1934), were made. Of the 489 individuals examined, 395, or 80.9 per cent, were positive for hookworms, the incidence being 84.2 per cent in the 253 males and 77.1 per cent in the 236 females. The average egg count of the entire series was 2,750, that of the males alone 3,200 and that of the females 2,300. The index of infection, according to the method of Chandler (1928), was 191 for the whole group. It is shown in Table 1 that the very young children of both sexes are very lightly parasitized, but the children of school age have practically the same egg counts as the adults. As shown in text fig. 1, this suggests a rapid acquisition of the parasites by the children. It is also noted that the males in the various age groups are more heavily infested than the corresponding groups of females, indicating that the opportunities of picking up the parasites are greater in the males than in the females. In the males the peak of the incidence curve occurs in the 50 + group, while that of the average egg count curve is found in the 5- to 14-year group. In the females the infestation in the 5- to 14-year group is quite heavy, but the peaks of both the incidence and egg-count curves occur in the 50 + group.

TABLE 1.—*Hookworm egg counts of ten groups of individuals in the Philippines, classified according to age and sex.*

| Locality. | 0 to 4 years. |  |  |  | 5 to 14 years. |  |  |  | 15 to 49 years. |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Cases. | Positive. | Incidence. | Average egg count per cc. | Cases. | Positive. | Incidence. | Average egg count per cc. | Cases. | Positive. | Incidence. | Average egg count per cc. |
| MALES. |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *Per cent.* |  |  |  | *Per cent.* |  |  |  | *Per cent.* |  |
| Pardo, Cebu | 16 | 6 | 37.5 | 400 | 90 | 78 | 86.7 | 3,800 | 128 | 111 | 86.7 | 3,000 |
| Palo, Leyte | 7 | 3 | 42.9 | 550 | 25 | 21 | 84.0 | 4,300 | 53 | 45 | 84.9 | 5,700 |
| Baao, Camarines Sur | 3 | 1 | 33.3 | 300 | 48 | 37 | 77.1 | 3,200 | 109 | 77 | 70.6 | 4,700 |
| Cotabato, Cotabato | 3 | 0 | 0.0 | 0 | 10 | 7 | 70.0 | 10,900 | 19 | 11 | 57.9 | 19,000 |
| Masbate, Masbate | 6 | 2 | 33.3 | 800 | 8 | 4 | 50.0 | 1,000 | 20 | 16 | 80.0 | 4,700 |
| Catbalogan, Samar | 0 | 0 | 0.0 | 0 | 10 | 10 | 100.0 | 1,800 | 12 | 10 | 83.3 | 2,000 |
| Cabuyao, Laguna | 1 | 0 | 0.0 | 0 | 10 | 5 | 50.0 | 1,600 | 33 | 22 | 66.6 | 1,800 |
| Paombong, Bulacan | 26 | 5 | 19.2 | 100 | 53 | 32 | 60.4 | 1,000 | 97 | 66 | 68.0 | 1,800 |
| Las Piñas, Rizal | 9 | 0 | 0.0 | 0 | 42 | 3 | 7.1 | 50 | 55 | 6 | 10.9 | 100 |
| Manila | 0 | 0 | 0.0 | 0 | 259 | 20 | 7.7 | 100 | 0 | 0 | 0.0 | 0 |
| FEMALES. |  |  |  |  |  |  |  |  |  |  |  |  |
| Pardo, Cebu | 18 | 10 | 55.5 | 300 | 72 | 61 | 84.7 | 2,900 | 122 | 89 | 73.0 | 2,000 |
| Palo, Leyte | 4 | 1 | 25.0 | 250 | 23 | 16 | 69.6 | 1,650 | 45 | 30 | 66.6 | 3,000 |
| Baao, Camarines Sur | 4 | 1 | 25.0 | 100 | 4 | 2 | 50.0 | 1,600 | 26 | 13 | 50.0 | 1,100 |
| Cotabato, Cotabato | 2 | 0 | 0.0 | 0 | 9 | 5 | 55.5 | 5,150 | 9 | 6 | 66.6 | 12,000 |
| Masbate, Masbate | 2 | 0 | 0.0 | 0 | 6 | 2 | 33.3 | 1,200 | 10 | 8 | 80.0 | 2,100 |
| Catbalogan, Samar | 0 | 0 | 0.0 | 0 | 0 | 0 | 0.0 | 0 | 10 | 8 | 80.0 | 1,000 |
| Cabuyao, Laguna | 0 | 0 | 0.0 | 0 | 15 | 4 | 26.7 | 200 | 37 | 12 | 32.4 | 1,100 |
| Paombong, Bulacan | 19 | 4 | 21.0 | 300 | 52 | 24 | 46.1 | 500 | 107 | 29 | 27.1 | 500 |
| Las Piñas, Rizal | 9 | 0 | 0.0 | 0 | 46 | 0 | 0.0 | 0 | 115 | 8 | 6.9 | 20 |
| Manila | 0 | 0 | 0.0 | 0 | 244 | 9 | 3.7 | 50 | 0 | 0 | 0.0 | 0 |

MALES.

| Locality. | 50 years and over. | | | | All ages, | | | |
|---|---|---|---|---|---|---|---|---|
| | Cases. | Posi-tive. | Incidence. | Average egg count per cc. | Cases. | Posi-tive. | Incidence. | Average egg count per cc. |
| | | | *Per cent.* | | | | *Per cent.* | |
| Pardo, Cebu | 19 | 18 | 94.7 | 3,600 | 253 | 213 | 84.2 | 3,200 |
| Palo, Leyte | 8 | 8 | 100.0 | 6,000 | 93 | 77 | 82.8 | 4,950 |
| Baao, Camarines Sur | 23 | 22 | 95.6 | 7,300 | 183 | 137 | 74.9 | 4,500 |
| Cotabato, Cotabato | 2 | 0 | 0.0 | 0 | 34 | 18 | 52.9 | 9,000 |
| Masbate, Masbate | 4 | 4 | 100.0 | 3,500 | 38 | 26 | 68.4 | 1,700 |
| Catbalogan, Samar | 0 | 0 | 0.0 | 0 | 22 | 20 | 90.9 | 1,000 |
| Cabuyao, Laguna | 11 | 6 | 54.5 | 800 | 55 | 33 | 60.0 | 1,600 |
| Paombong, Bulacan | 23 | 9 | 39.1 | 900 | 199 | 112 | 56.3 | 1,200 |
| Las Piñas, Rizal | 19 | 4 | 21.0 | 700 | 125 | 13 | 10.4 | 150 |
| Manila | 0 | 0 | 0.0 | 0 | 259 | 20 | 7.7 | 100 |
| FEMALES. | | | | | | | | |
| Pardo, Cebu | 24 | 22 | 91.7 | 3,900 | 236 | 182 | 77.1 | 2,300 |
| Palo, Leyte | 4 | 3 | 75.0 | 3,300 | 76 | 50 | 65.8 | 2,500 |
| Baao, Camarines Sur | 3 | 1 | 33.3 | 150 | 37 | 17 | 45.9 | 1,000 |
| Cotabato, Cotabato | 0 | 0 | 0.0 | 0 | 20 | 11 | 55.0 | 7,700 |
| Masbate, Masbate | 0 | 0 | 0.0 | 0 | 18 | 10 | 55.5 | 800 |
| Catbalogan, Samar | 2 | 2 | 100.0 | 1,000 | 12 | 10 | 83.3 | 1,000 |
| Cabuyao, Laguna | 9 | 1 | 11.1 | 50 | 61 | 17 | 27.9 | 500 |
| Paombong, Bulacan | 24 | 8 | 33.3 | 700 | 202 | 65 | 32.2 | 500 |
| Las Piñas, Rizal | 20 | 0 | 0.0 | 0 | 190 | 8 | 4.2 | 10 |
| Manila | 0 | 0 | 0.0 | 0 | 244 | 9 | 3.7 | 50 |

TABLE 2.—*Average hæmoglobin percentages of Pardo series arranged according to hookworm infestation intensity groups.*

| Hookworm infestation groups in eggs per cc. | Ages 0 to 4 yrs. | | Ages 5 to 14 yrs. | | Ages 15+ yrs. | | All ages. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Cases. | Mean Hb reading. | Cases. | Mean Hb reading. | Cases. | Mean Hb reading. | Cases. | Per cent of sex. | Mean Hb reading. |
| MALES. | | | | | | | | | |
| Negatives | 10 | 74.0±1.77 | 12 | 75.0±1.64 | 18 | 82.9±0.84 | 40 | 15.8 | 78.2±0.88 |
| 100 to 999 | 4 | 68.8±2.29 | 11 | 70.0±1.84 | 25 | 79.6±0.90 | 40 | 15.8 | 76.0±0.93 |
| 1,000 to 4,999 | 2 | 72.5±1.20 | 46 | 72.0±0.60 | 74 | 77.8±0.66 | 122 | 48.2 | 75.5±0.51 |
| 5,000 to 9,999 | 0 | ------------ | 8 | 70.0±1.94 | 19 | 73.7±1.61 | 27 | 10.7 | 73.6±1.41 |
| 10,000+ | 0 | ------------ | 13 | 57.3±1.50 | 11 | 53.6±2.11 | 24 | 9.5 | 55.6±1.29 |
| Total males | 16 | ------------ | 90 | ------------ | 147 | ------------ | 253 | 100.0 | ------------ |
| FEMALES. | | | | | | | | | |
| Negatives | 8 | 78.1±1.31 | 11 | 75.6±1.26 | 35 | 80.0±0.37 | 54 | 22.9 | 78.9±0.70 |
| 100 to 999 | 8 | 72.0±1.21 | 13 | 76.2±1.68 | 35 | 78.1±0.86 | 56 | 23.7 | 76.8±0.81 |
| 1,000 to 4,999 | 2 | 72.5±0.59 | 33 | 75.7±0.94 | 56 | 76.8±0.63 | 91 | 38.5 | 76.3±0.48 |
| 5,000 to 9,999 | 0 | ------------ | 13 | 70.8±1.82 | 18 | 72.8±0.89 | 31 | 13.2 | 71.9±1.09 |
| 10,000+ | 0 | ------------ | 2 | 42.5±3.57 | 2 | 42.5±3.57 | 4 | 1.7 | 42.5±2.52 |
| Total females | 18 | ------------ | 72 | ------------ | 146 | ------------ | 236 | 100.0 | ------------ |
| Total both sexes | 34 | ------------ | 162 | ------------ | 293 | ------------ | 489 | ------------ | ------------ |

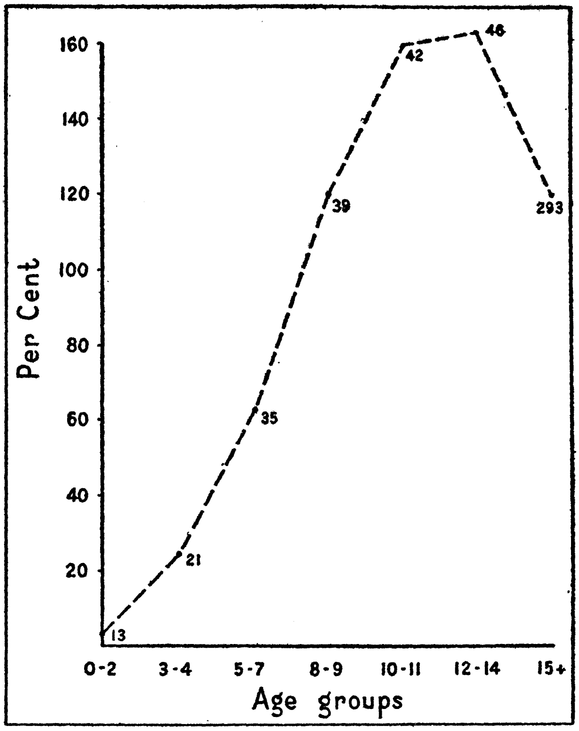

FIG. 1. A representation of the rate of acquisition of hookworm parasites in the children of Pardo, Cebu. The average egg count for each group is given as a percentage of the average count of the adults (15 + years). The figures at each point in the curve give the number of cases used in computing the value.

Table 2, in which the individual egg counts are arranged in intensity groups, shows the same age and sex differences between the infestations. Among the males 31.6 per cent and among the females 46.6 per cent fall in the negative and lowest egg-count groups, in which the estimated number of adult worms harbored, based on the factor of 100 eggs per adult worm proposed by Cort, Stoll, and Grant (1926), is less than 10. On the other hand among the most heavily infested cases the number of the males is greater than that of the females, there being 24 of the former and only 4 of the latter with counts of 10,000 + eggs per cubic centimeter of fæces. To a large extent the preponderance of these heavily infested cases among the males is responsible for the much higher average egg counts of the males as compared with the counts of the females. The highest individual counts in the two sexes were 20,800 and 20,400 and were met with in a male 45 years old and in a female 60 years old, respectively.

*Baao, Camarines Sur.*—In this locality 220 persons were examined. Of the 183 males, 137, or 74.9 per cent, were hookworm positives, their average egg count being 4,500. Of the 37 females, 17, or 45.9 per cent, were infested, their average egg count being 1,000. The incidence in the entire series is thus 70 per cent and the average egg count 3,900. By comparing these figures with those of the Pardo series it will be seen that the incidence of the parasites is lower in Baao, but the degree of infestation is more than twice as heavy. The index of infection, which was found to be 300, is much higher. As in the Pardo series, the males appear to be more heavily parasitized than the females. The analysis into age groups, however, shows a much lighter infestation in the school children, indicating a slower rate of acquisition of the parasites by the Baao children compared with the Pardo children (text fig. 2). An analysis of the counts into intensity groups shows a relatively greater number of heavily infested cases, which account to a large extent for the higher average egg count of the group. The highest individual counts for the two sexes are 102,000

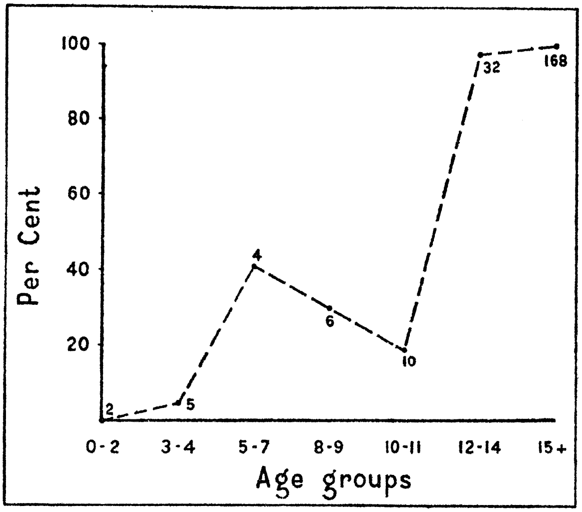

FIG. 2. A representation of the rate of acquisition of hookworm parasites in the children of Baao, Camarines Sur (method used as in text fig. 1).

and 32,000 and were encountered in a male 48 years old and in a female 32 years old, respectively.

*Palo, Leyte.*—The number of persons examined in this place was 169, of which 93 were males and 76 were females. The number of hookworm positives was 127, or 75.1 per cent, and the average egg count was 3,850. The incidence in the males alone was 82.8 per cent and the average egg count 4,950, while in the females the incidence was 65.8 per cent and the average egg count 2,500. The index of infection was found to be 290.

The analysis of the data according to age and sex shows that the males are about twice as heavily infested as the females and that the children of school age have more than one-half of the infestation of the adults. The severity of the infestation in this locality is indicated by the large number of individuals (24.8 per cent) found to be heavily parasitized and apparently suffering from hookworm disease.

*Cotabato, Cotabato.*—Only 54 individuals were examined in this place, of which 34 were males and 20 females. The males had an incidence of 52.9 per cent and an average count of 9,000 per cubic centimeter of fæces. The incidence in the females was 55 per cent and the average egg count 7,700. Considering the entire group, the incidence was 53.7 per cent and the average egg count 8,500. The degree of infestation is thus much heavier than that of either the Pardo, Baao, or Palo series, but this is probably due to the fact that the majority of those examined were adults, a large number of whom were heavily parasitized. As a matter of record the highest individual counts were 59,000 and 38,200 and were met with in a male 10 years old and in a female 17 years old, respectively. The data, although incomplete, may be taken as an indication of the importance of hookworm parasites in this locality.

*Masbate, Masbate.*—The number of cases examined in this place consists of only 56 individuals, of whom 36, or 73.2 per cent, were positive for hookworms. The average egg count of the entire group was 1,400. The incidence in the 38 males was 68.4 per cent and the average egg count 1,700; in the 18 females the incidence was 55.5 per cent and the average egg count 800. We had expected to find the parasites of medical importance in this locality, but the data obtained denote only a low grade of hookworm infestation. This is probably explained by the fact that the persons who submitted fæcal samples lived in or near

TABLE 3.—*Average hæmoglobin percentages of Paombong series arranged according to hookworm infestation intensity groups.*

MALES.

| Hookworm infestation groups in eggs per cc. | Ages 0 to 4 yrs. |  | Ages 5 to 14 yrs. |  | Ages 15+ yrs. |  | All ages. |  |  |
|---|---|---|---|---|---|---|---|---|---|
|  | Cases. | Mean Hb reading. | Cases. | Mean Hb reading. | Cases. | Mean Hb reading. | Cases. | Per cent of sex. | Mean Hb reading. |
| Negative | 21 | 78.9±1.50 | 21 | 82.1±1.10 | 45 | 79.5±0.58 | 87 | 43.7 | 80.0±0.66 |
| 100 to 999 | 2 | 77.5±1.20 | 13 | 77.7±0.79 | 12 | 77.5±0.56 | 27 | 13.6 | 77.5±0.67 |
| 1,000 to 4,999 | 3 | 78.3±2.64 | 13 | 80.0±0.73 | 40 | 79.1±0.40 | 56 | 28.1 | 79.1±0.74 |
| 5,000 to 9,999 | 0 |  | 6 | 78.3±1.45 | 22 | 80.0±1.10 | 28 | 14.1 | 78.6±0.87 |
| 10,000+ | 0 |  | 0 |  | 1 | 70.0 | 1 | 0.5 | 70.0 |
| Total males | 26 |  | 53 |  | 120 |  | 199 | 100.0 |  |

FEMALES.

| Hookworm infestation groups in eggs per cc. | Ages 0 to 4 yrs. |  | Ages 5 to 14 yrs. |  | Ages 15+ yrs. |  | All ages. |  |  |
|---|---|---|---|---|---|---|---|---|---|
|  | Cases. | Mean Hb reading. | Cases. | Mean Hb reading. | Cases. | Mean Hb reading. | Cases. | Per cent of sex. | Mean Hb reading. |
| Negative | 15 | 78.6±1.92 | 28 | 77.9±1.78 | 94 | 79.4±0.70 | 137 | 67.8 | 78.6±0.86 |
| 100 to 999 | 3 | 78.6±2.61 | 11 | 80.0±1.60 | 12 | 76.6±2.20 | 26 | 12.9 | 78.7±0.86 |
| 1,000 to 4,999 | 1 | 76.6 | 9 | 78.0±0.45 | 19 | 75.7±1.30 | 29 | 14.4 | 76.9±0.57 |
| 5,000 to 9,999 | 0 | 77.5±1.45 | 4 | 77.5±1.48 | 6 | 76.6±2.20 | 10 | 4.9 | 77.3±0.81 |
| 10,000+ | 0 |  | 0 |  | 0 |  | 0 |  |  |
| Total females | 19 |  | 52 |  | 131 |  | 202 | 100.0 |  |
| Total both sexes | 45 |  | 105 |  | 251 |  | 401 |  |  |

the town center, which is very close to the sea, and the people deposited their fæces near the seashore or directly into the water. Under such conditions the danger of acquiring hookworm parasites is not very great. The high average egg count of the males in the 5- to 14-year group is due to a single heavily infested case, a boy 14 years old, whose egg count was 34,000.

*Catbalogan, Samar.*—In spite of the small number of cases examined, we have decided to record our observations from this place in order to complete our report. Of the 34 individuals examined, the majority of whom were over 10 years of age, 30, or 88.2 per cent, were hookworm positives. The average egg count, however, was only 1,000, not a single case presenting a count of more than 5,000. It would thus appear that the infestation in Catbalogan is of the light type, but our low figures are explained by the fact that, as in Masbate, nearly all of the individuals who submitted fæcal samples lived in the poblacion, where the environment is not favorable for the propagation of hookworms due to its proximity to the seashore.

*Paombong, Bulacan.*—Our hookworm egg counts from this town represent the results of the examination of the fæcal samples on which our egg counts for ascaris and trichuris from the same town, as reported in an earlier paper (Tubangui, Basaca, and Pasco, 1934), were made. The group was composed of 401 individuals, of which 177, or 44.1 per cent, were found positive for hookworms, the incidence in the 199 males being 56.3 per cent and in the 202 females 32.2 per cent. The average egg count of the entire series was 850 per cubic centimeter of fæces, that of the males alone being 1,200 and that of the females 500. The analysis of the data according to age and sex shows that the infestations in the different groups are uniformly light or mild in character. As a matter of fact there was only one individual in the entire series who had an egg count of 11,600, the counts of the majority of the other hookworm positives not being over 3,000 (Table 3). These figures and the index of infection, which was only 40, denote a very low grade of hookworm infestation which, in the words of Chandler (1920), "is so small that it is of no practical consequence and can safely be ignored as an important public health problem."

*Cabuyao, Laguna.*—This series is composed of 116 persons, of which 50, or 43.1 per cent, were positive for hookworms, the incidence in the 55 males being 60 per cent and in the 61 females 27.9 per cent. The average egg count of the entire series was

1,020, that of the males alone 1,200 and that of the females 500. These data denote a low grade of hookworm infestation, but there were in the series five heavily infested individuals, one of whom in particular attracted our attention due to his extreme pallor (hæmoglobin reading, 40) and physical weakness. He was in other words suffering from typical hookworm disease. One of us (M. B.) treated him for hookworms and he made a rapid recovery. It would appear from these observations that Cabuyao is one of the few places in the provinces near Manila where hookworms find suitable environment for their development. As a matter of fact, the index of infection, which was calculated to be 180, differs but little from that of Pardo, Cebu.

*Las Piñas, Rizal.*—Of the 315 persons examined in this place, only 21, or 6.6 per cent, were positive for hookworms, the incidence in the 125 males being 10.4 per cent and in the 190 females 4.2 per cent. All of the positive cases were very lightly infested, the average egg count of the entire series being 70, that of the males alone 150, and that of the females 10. The index of infection was calculated to be only 10, showing that the hookworm infestation in Las Piñas, Rizal, can be safely overlooked as a public-health problem.

*Manila.*—As already stated, this series is composed entirely of school children, who were the same ones on whom our ascaris and trichuris counts, as reported in an earlier paper, were based. Of the 503 children examined, only 29, or 5.8 per cent, were positive for hookworms, the incidence in the 259 boys being 7.7 per cent and in the 244 girls 3.7 per cent. The average egg count of the entire group was only 50, the intensity of the infestation in the two sexes being the same. Comparison of these data with those of the children of the other series of individuals examined shows that parasitism in Manila is very light and therefore negligible from the public-health standpoint. As a matter of fact, the index of infection was only 10.

## GEOGRAPHICAL DISTRIBUTION OF HOOKWORM PARASITES IN THE PHILIPPINES

The data given above show that the degree of hookworm infestation in the Philippines varies in the different localities. For purposes of comparison the infestations of the ten groups of individuals examined during the survey are represented graphically by means of bar diagrams in text fig. 3, in which the average egg counts of the Pardo series, classified according to age and sex, are each given a weight of 50, and the ratio to this figure of the corresponding counts of each of the

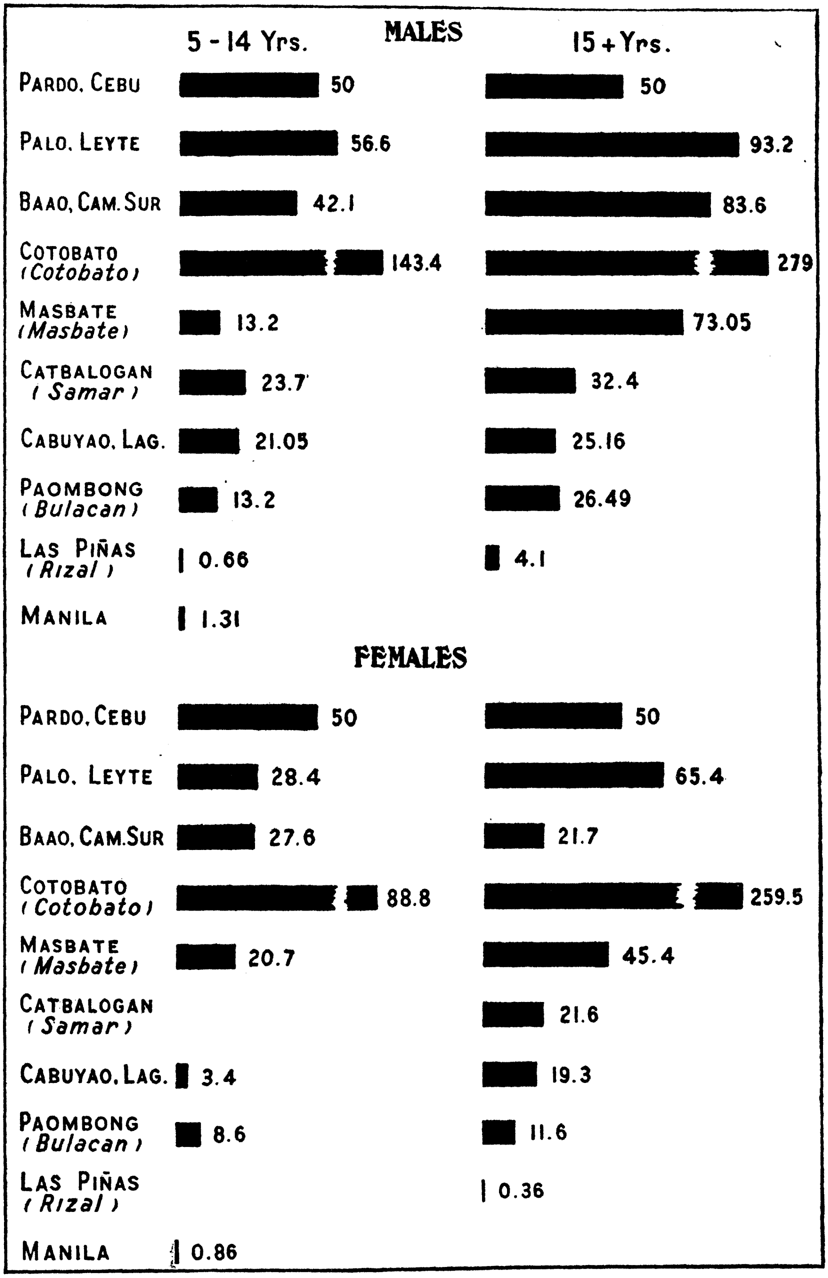

FIG. 3. A representation of the differences between the hookworm egg counts of the different series of individuals examined.

other series is then calculated. Children from 0 to 4 years of age have not been included in the comparisons, because of their uniformly very light infestations.

According to the bar diagrams the places where the infestations were found to be heaviest were Pardo, Cebu; Palo, Leyte; Baao, Camarines Sur; and Cotabato, Cotabato. The lightest infestations, on the other hand, were encountered in Manila; Las Piñas, Rizal; Paombong, Bulacan; and Cabuyao, Laguna. By obtaining the general average of the counts of the individuals from Pardo, Palo, Baao, and Cotabato, it is calculated that the intensity of the parasitism in these four localities is almost nine times as heavy as that in Manila, Las Piñas, Paombong, and Cabuyao. Our data from Masbate and Catbalogan are really too limited to be of much significance, but there are indications that in these islands, especially in the interior towns, hookworms may be found to be of public-health importance.

## HOOKWORM DISEASE

In view of the skepticism regarding the medical importance of hookworms in the Philippines, we shall record our observations on the existence and prevalence of hookworm disease in the different localities covered by our survey, based on the results of our hæmoglobin determinations. We desired to utilize for this purpose all of our available data, but the occurrence in endemic form in several of the places visited of either malaria or schistosomiasis japonica or both, which, like hookworm disease, are characterized by anæmia, rendered the interpretation of many of our hæmoglobin averages difficult. Although the Uncinariasis Commission to the Orient (Darling, Barber, and Hacker, 1920) concluded from its findings that the hæmoglobin index is a reliable guide in estimating the severity of hookworm disease irrespective of other anæmia-producing conditions, we have decided to present only the data obtained in Pardo and Paombong in order to exclude from the discussion these complicating factors. As far as we were able to ascertain both by direct observation and inquiry from private and public-health physicians, only these two towns were free endemically from malaria and schistosomiasis.

Tables 2 and 3 give the hæmoglobin averages of the Pardo and Paombong series, analyzed according to age and sex and lined up for the various hookworm intensity groups. It is evident from the figures that a definite correlation exists between the hæmoglobin index and the number of parasites harbored, the hæmoglobin readings being usually lower in the higher egg count groups. In the Paombong series none of the hæmoglobin averages is below 70, due to the lightness of the infestations, but in the Pardo series they are very reduced in the group of the heavily infested individuals. In the latter series, as shown graphically in text fig. 4, the hæmoglobin curve falls very gradually to 72.6 ± 1.31 in the males and 71.9 ± 1.09 in the females in the 5,000 to 9,999 egg-count groups, and then abruptly to 55.6 ± 1.29 in the males and 42.5 ± 2.57 in the females in the 10,000 + groups of the two sexes. These hæmoglobin averages seem to suggest that in Filipinos the defenses of the body against the toxic effects

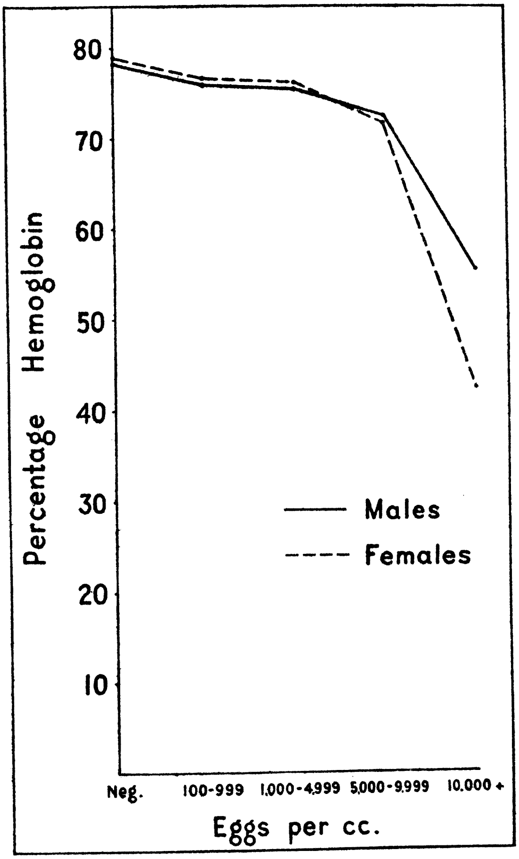

FIG. 4. Hæmoglobin averages of Pardo series as related to hookworm intensity groups.

of hookworms are capable of holding their ground in moderately heavy infestations, in which the number of parasites harbored is less than 100. They tally with the findings of Darling, Barber, and Hacker (1920) in Java, where it was noted "that the losses (hæmoglobin) due to hookworm disease were markedly apparent only after the 100-worm group had been passed." According to the factor proposed by Cort and his associates (1926) in estimating the number of adult worms from egg counts, our 10,000 + egg-count group would include individuals harboring 100 + adult parasites.

Our findings thus prove the claim of Leach and his associates (1923) of the existence of hookworm disease as a clinical entity in the Philippines. As a public-health problem, however, the disease is not evenly distributed, being more prevalent in places where the danger of acquiring heavy hookworm infestation is great due to favorable environmental conditions. To our mind this uneven distribution of the parasites serves to explain the failure of earlier investigators in the Islands to find cases of hookworm disease; for it will be recalled that the majority of them made their observations in Manila and in some of the neighboring provinces where, according to our data, the infestations are light and apparently of no medical importance.

## FACTORS RESPONSIBLE FOR THE DISTRIBUTION OF HOOKWORM PARASITES AND DISEASE IN THE PHILIPPINES

Some of the earlier investigators observed slight differences in the geographical distribution of hookworm parasites in the Philippines and proposed various explanations to account for the differences. Rissler and Gomez (1909) noted that "at Las Piñas where the soil was sandy the infection was found to be greater than in the places where the soil was of clay loam." This is in contrast to one of the explanations given by Stitt (1911), who ascribed the low incidence of the parasites in Cavite Province to the uneven distribution of the annual rainfall and to the sandy nature of the soil. Rissler and Gomez (1910) and Willets (1911) found hookworms to be more prevalent in Cagayan Valley than in the other sections of the country where surveys had been made due, according to Willets, to the favorable character of the soil, the shade afforded by tobacco plants, and the occupation of the people.

As pointed out by Cort, Stoll, and Grant (1929), the factors that influence the spread of hookworm parasites in any region are the climate of the region and the habits of the people. Since these factors are intimately linked with the manner of development of hookworms, it will be necessary to review briefly the life cycle of the parasites. The adult worms live in the small intestines of man, and the eggs laid by the female parasites reach the outside world with the fæces. In places where improper methods of fæcal disposal are practiced, the ova are spread on the ground where, if the environment is sufficiently warm and moist, they hatch and later develop into infective larvæ. These larvæ gain entrance into the human system usually through the bare skin of the feet and other exposed parts of the body. For this reason people who habitually go about with shoes and other footwear are usually free from hookworms.

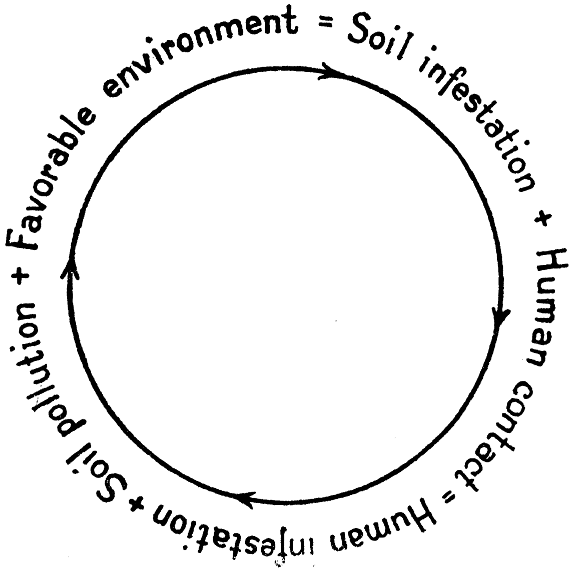
Favorable environment = Soil infestation
+ Human contact = Human infestation
+ Soil pollution
+

FIG. 5. A representation of the factors involved in the spread of hookworm infestation. (From Cort, 1922.)

The manner in which the factors mentioned above are involved in the propagation of hookworms is represented graphically in text fig. 5. The attempt to correlate these factors with the results of our egg counts showed that the uneven distribution of the parasites and the disease cannot be attributed to differences in the habits of the people, for in all of the places visited evidences of pollution of the soil with human fæces due to primitive methods of fæcal disposal were encountered and the majority of the individuals examined went habitually barefooted and were mostly engaged in occupations that exposed them to the parasites. Therefore, there remains to be considered the environmental factor, to which we believe, is due the unequal distribution of the parasitism.

Under environment the two most important epidemiological factors are soil temperature and soil humidity; for, as already stated, hookworm larvæ have certain optimum requirements of heat and moisture for their development. These in turn are controlled by two agencies in warm countries: primarily, by the amount and distribution of the annual rainfall; and, secondarily, by the presence and nature of the vegetation.

Regarding the first agency, the average annual rainfall in the Philippines, according to Father Coronas, is 2,366.1 millimeters, the annual mean in any single place varying between 989.8 and 4,597.6 millimeters. The yearly precipitation in the Archipelago thus compares favorably with that in other countries where hookworms are a major public-health problem. According to Father Coronas, however, "the most interesting feature of the climate of the Philippines is the monthly distribution of rainfall. If this element would be about the same throughout the Archipelago, there would hardly be any difference of climate in the Philippines. But as it is, the different position of the islands which makes them or part of them more or less exposed to the general winds prevailing in the Philippines, both in winter and in summer, is the principal cause of our different kinds of climate in spite of the relatively small extension of the Archipelago from east to west, especially in Luzon . . . Based on these observations, and taking in consideration the greater or less prevalence of either of the two most important periods of rain, we have tried to divide this monthly distribution of rainfall into four types: two altogether opposite types and two other intermediate types." These types of climate are as follows: First type, in which there are two pronounced seasons, dry in winter and spring, wet in summer and autumn; second type, in which there is no dry season, with a very pronounced maximum rain period in winter; third, or intermediate A, type, in which there is no very pronounced maximum rain period but only a short dry season lasting from one to three months; and fourth, or intermediate B, type, in which there is no very pronounced maximum rain period and no dry season. These four types of monthly distribution of rainfall are illustrated graphically in text fig. 6

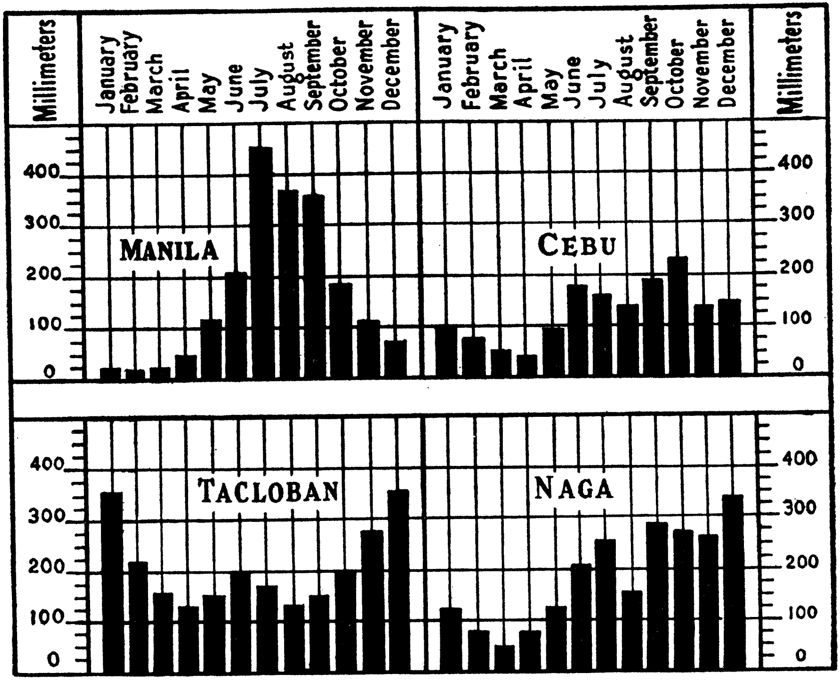

FIG. 6. Four types of monthly distribution of the annual rainfall in the Philippines. (From Coronas, 1920.)

and the different places in the Islands where they are met with are shown in text fig. 7.

The influence of these four types of climate on the temperature and on the moisture content of the soil needs hardly to be discussed, for it can be easily understood that other things being equal, the warmth and the humidity of the ground will be more constant in places where rains are more frequent than in localities where there are two pronounced seasons. With regard to the influence of the vegetation, it is well known that shaded areas are cooler and retain their moisture content longer than barren or exposed areas due to the rôle of trees and other plants in preventing the rapid evaporation of the soil moisture.

From these observations it is clear why hookworm parasites should be unevenly distributed in the Philippines. In places like Manila, Bulacan, Rizal, and Laguna, where the ground is either too wet or too dry during the greater part of the year for the normal development of hookworm larvæ due to the existence of two pronounced seasons, the infestations in the majority of cases are light and of little or no medical importance. On the other hand, in places like Cebu, Leyte, Camarines Sur, Cotabato, and possibly in Samar and Masbate, where the temperature and humidity of the soil are more constant due to the more uniform distribution of the annual rainfall and the presence of large numbers of coconut trees in the neighborhood of the houses, the environment is favorable for the propagation of the parasites. In such places the danger of acquiring heavy hookworm infestations and of developing hookworm disease is great.

## SUMMARY

In order to find a plausible explanation for the varying opinions regarding the medical significance of hookworm infestations in the Philippines, a quantitative hookworm survey was carried out in several widely separated places in the Islands.

A total of 2,357 persons were examined, distributed as follows: 169 in Palo, Leyte; 503 in Manila; 489 in Pardo, Cebu; 401 in Paombong, Bulacan; 116 in Cabuyao, Laguna; 220 in Baao, Camarines Sur; 56 in Masbate, Masbate; 34 in Catbalogan, Samar; 315 in Las Piñas, Rizal; and 54 in Cotabato, Cotabato. Those examined in Manila were school children from 7 to 11 years of age, while those examined in the other places represented mixed populations.

The egg counts showed an uneven distribution of hookworm infestation, both the incidence and the intensity of the parasitism being much higher in the groups from Cebu, Leyte, Cotabato, and Camarines Sur.

It was also noted that hookworm disease, as judged from reduced hæmoglobin percentages, was more prevalent in these four places and was invariably met with in heavily infested individuals having egg counts of 10,000 + per cubic centimeter of fæces.

The differences between the infestations could not be attributed to differences in the habits of the people examined, for in all of the places visited, with the exception of Manila, the methods of waste disposal were of the primitive type and the large majority of the people went habitually barefooted and were mostly engaged in occupations which exposed them to hookworms.

The differences were believed to be due to climatic and other environmental factors that influence the temperature and the moisture content of the soil. The fact was brought out that the distribution of the annual rainfall in the Philippines varies in

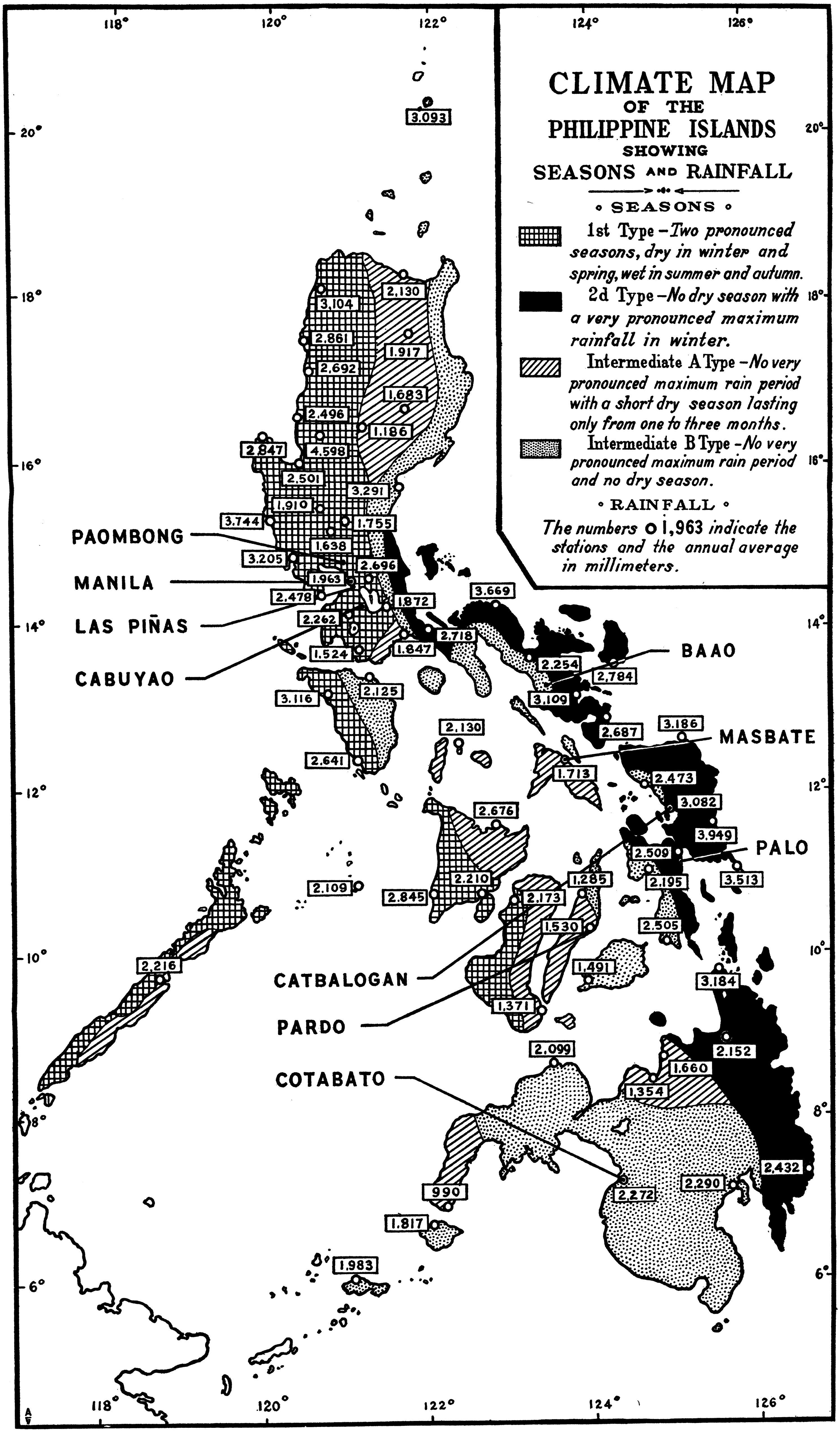

Fig. 7. Climate and weather map of the Philippines, showing the various places covered by the survey. (Adapted from Coronas, 1920.)

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different regions. In some localities there are two pronounced seasons, one-half of the year being dry and the other half wet; while in other places the rains are more uniformly distributed and there is either no dry season or only a short one.

In places like Cebu, Leyte, Cotabato, and Camarines Sur, where the soil is sufficiently warm and moist during the greater part of the year due to a more or less uniform distribution of the annual rainfall and the presence in the neighborhood of human habitations of a covering vegetation that prevents the too rapid evaporation of water from the ground, the environment was considered favorable for the development of hookworm larvæ. This would explain the prevalence of heavy hookworm infestations and disease in these localities.

In places like Manila, Bulacan, Rizal, and Laguna, where the soil is either too wet or too dry during the greater part of the year due to the existence of two pronounced seasons and the absence of covering vegetations, the environment is not favorable for the spread of hookworms. This would explain why the infestations encountered in such places were light and apparently of no public-health importance.

It was concluded that the early workers in medical zoölogy underestimated the importance of hookworms in the Philippines due to the fact that the majority of them carried out their observations in Manila and in the neighboring provinces where, as stated above, the infestations appear to be very light and of no clinical significance.

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# ILLUSTRATIONS

## TEXT FIGURES

FIG. 1. A representation of the rate of acquisition of hookworm parasites in the children of Pardo, Cebu. The average egg count for each group is given as a percentage of the average count of the adults (15 + years). The figures at each point in the curve give the number of cases used in computing the value.

2. A representation of the rate of acquisition of hookworm parasites in the children of Baao, Camarines Sur (method as in text fig. 1).

3. A representation of the differences between the hookworm egg counts of the different series of individuals examined.

4. Hæmoglobin averages of Pardo series as related to hookworm intensity groups.

5. A representation of the factors involved in the spread of hookworm infestation. (From Cort, 1922.)

6. Four types of monthly distribution of the annual rainfall in the Philippines. (From Coronas, 1920.)

7. Climate and weather map of the Philippines, showing the various places covered by the survey. (Adapted from Coronas, 1920.)

# THE PURIFICATION OF ANTIDYSENTERIC SERUM WITH SODIUM SULPHATE

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ONE PLATE

As early as 1888 Hofmeister studied the precipitating qualities of sodium sulphate with protein substances, and Pinkus (1901) employed the same salt for the precipitation of various kinds of serum albumins. The latter author showed that the precipitated proteids contained little salt (about 5 per cent), the concentration of which was found to be practically nontoxic. Brunner and Pinkus (1907) employed sodium sulphate in the separation of diphtheria antitoxin by allowing the salt to crystallize out in the refrigerator and then thawing the concentrated antitoxin. The diphtheria antitoxin recovered by this method was found to be very potent, the liquid containing but 6 per cent of sodium sulphate. In later years the salt has been used as a globulin precipitant in the determination of blood proteins (Howe, 1921) and in the study of the antigenic properties of the fractional precipitated proteins of serum (Pirowsky, 1933). Felton (1928) found this salt very convenient and useful in the concentration of pneumococcus antibody, and Maitra et al. (1933), in the concentration of antivenomous serum. The concentration with sodium sulphate of antidysenteric serum as well as antitetanic and antidiphtheritic sera was independently studied by Homer (1920) and by MacConkey (1924). The amount of sodium sulphate sufficient to salt out the different proteids of normal and immune sera was extensively discussed by the workers cited above.

Various authors have studied the sensitizing properties of the fractional proteids prepared from the serum of different animals, especially horse serum. Dale and Hartley (1916) remarked that, for the purpose of reducing serum reactions, the elimination of albumin seems to be as important as that of euglobulin when the pseudoglobulin is the fraction carrying the therapeutic power. Their observation of the relatively long latent period of the sensitiveness to albumin is also suggestive in connection with the successive crops of serum rash that have been recorded in certain patients as the result of one injection of a serum.

The main purpose of this work has been to get rid of most of the seroalbumin in antidysenteric serum and still be able to recover a concentrated, or rather purified but potent, serum.

## METHOD EMPLOYED

The following procedure has been tried with several samples of antidysenteric serum. The serum is diluted with an equal amount of distilled water and warmed in the incubator at 40° C. for about seven hours. At the same time an amount of anhydrous sodium sulphate equal in grams to 20 per cent of the total volume of the diluted serum is also warmed in the incubator. After seven hours the dry sodium sulphate is added to the diluted serum with thorough shaking. The solution is allowed to stand overnight in the incubator at 40° C. and filtered inside the incubator through thick filter paper (Whatman No. 50) the following morning. The clear filtrate, consisting of seroalbumin and salt, has a dark amber color. This filtrate is discarded. The precipitate is washed with 20 per cent aqueous solution of sodium sulphate, filling the funnel twice. The last washing is conveniently started at 4 o'clock in the afternoon so as to allow the liquid to drip overnight inside the incubator. The following morning the precipitate appears in a whitish pasty form. The filter paper with the precipitate is then carefully removed from the funnel and folded in two. The edges of the paper are likewise folded so as to prevent the precipitate from running out. The precipitate is then dried by placing it between several sheets of ordinary filter paper (coarse, German make) in a press for twenty-four hours. After that time some of the sodium sulphate will be seen to crystallize out around the edges of the filter paper and the precipitate will appear as a whitish semisolid cake. With the aid of a spatula the precipitate is separated from the filter paper and transferred into a flask. It is then redissolved in a sufficient quantity of sterile distilled water to bring up the volume equal to 20 per cent of the original volume of the serum. Sodium carbonate in an amount equal to 3 per cent of the weight of the precipitate may be added to the solution in order to facilitate the dialysis which follows. Before the solution is placed in the dialyzing bag, chloroform is added, using 0.5 cc of the latter for the precipitate collected from 1 liter of serum. The bag is then tied to, and partly immersed in, a dialyzing tank, the temperature of the water of which is maintained at about 20° C. by means of an ice-box arrangement in which the tank is inclosed (Plate 1). In order to prevent the growth of fungi on the parchment, a sack containing crystals of thymol is submerged in the dialyzing tank. The thymol could probably be omitted, for the water is fairly cool and the period of dialysis is relatively short, being only three days. Twenty kilos of ordinary ice has been found sufficient to maintain the temperature in the dialyzing tank for twenty-four hours. To the dialysate sodium chloride is added in the proportion of 1 gram salt to each liter of the dialysate. As a preservative phenol is added in the amount of 0.5 per cent, and the dialysate is then passed through a Seitz filter.

The procedure as described above is not very complicated, but precautions should be observed that the salting of the serum be carried on at a temperature not lower than 35° C. and not higher than 40° C. The water in the tank should be maintained at a temperature between 18° and 23° C. by letting melted ice flow directly into the tank. If it happens that the temperature goes below 18° C., the water in the tank may be allowed to run for some time by turning the faucet for the outflow. The addition of phenol as preservative to the serum before the process of purification has been observed to retard filtration.

TABLE 1.—*The weight of pressed globulin precipitate and the amount of sodium sulphate before and after dialysis.*

| Antidysenteric serum (sample No.). | Method used.[a] | Weight of cake per liter serum. | Sodium sulphate. | |
|---|---|---|---|---|
| | | | Before dialysis. | After dialysis. |
| | | *g.* | *Per cent.* | *Per cent.* |
| I | Regular, salted 20 per cent | 138.8 | | |
| II (with toxoid) | do | 191.2 | | |
| III (lot 12) | Regular, salted 18 per cent | 223.05 | | |
| IV | Thawed till no crystallization | | 3.99 | 0.108 |
| V | do | | 4.08 | |
| VI | Regular, salted 20 per cent | | | 0.12 |
| VII | do | | | 0.062 |

[a] "Regular," means that the purified serum was directly dialyzed; "thawed," means that the serum after redissolving the cake was subjected to alternate freezing and thawing until no more crystals formed in the last freezing.

The volume of purified serum obtained according to our method is about two-thirds the original volume of the serum, and the amount of sodium sulphate present has been found to range from 0.062 to 0.12 per cent (Table 1).

## PROTECTION TESTS

The potency of the purified serum was tested, using mice weighing from 18 to 20 grams. The toxin employed in the tests was selected from three broth cultures that were separately inoculated with three strains of *B. dysenteriæ* (Shiga) and incubated for two weeks. As shown in Table 2 the toxicity of these cultures was found to be practically the same, for which reason only the toxin of one strain of organism (Shiga–15) was used in all the protection tests. The results of the tests, as recorded in Table 3, show that the antidysenteric serum to which soda was added before dialysis has higher protective properties than the serum that was dialyzed without soda. The antitoxic properties of the former compare favorably with those of the untreated original antidysenteric serum. The serum designated as lot 12 in Table 3 was produced according to our regular method of immunization. This was purified and dialyzed with soda and was found to be just as potent as that produced with formalized toxin and bacteria. Our experience with the latter method of immunization, however, is limited to the use of only three horses so that we are not yet in a position to give an opinion as to its advantages over other methods of immunization.

TABLE 2.—*The toxicity of three broth toxins of B. dysenteriæ (Shiga) by intravenous injections.*

| Broth toxin. | Amount injected. | Mice injected May 4, 1935. | Dates of death. | | |
|---|---|---|---|---|---|
| | | | May 5. | May 6. | May 8, 1935. |
| | *cc.* | | | | |
| Shiga–15 | 0.2 | 2 | 1 | ------ | 1 |
| Do | 0.5 | 2 | 2 | ------ | ------ |
| Shiga–16 | 0.2 | 2 | 1 | ------ | 1 |
| Do | 0.5 | 2 | 1 | 1 | ------ |
| Shiga–18 | 0.2 | 2 | ------ | 1 | 1 |
| Do | 0.5 | 2 | 1 | 1 | ------ |

## DISCUSSION

An inquiry into the methods of producing antidysenteric serum has been discussed and reported by Schöbl (1925). The method, the amount of salt in the purified antidysenteric serum described in this paper represents a slight modification of that used by Brunner and Pinkus in the concentration of diphtheria antitoxin with sodium sulphate. By following the original method, the amount of salt in the purified antidysenteric serum after repeated freezing and thawing ranged from 3.99 to 4.08 per cent, and this made the filtration of the serum difficult due to the concentration of salt and gelatinous proteids which clogged the pores of the filter. Besides this difficulty the filtrate was found to have lost much of its immunologic properties. Instead therefore of freezing and thawing the serum, the precipitate was dissolved in water and immediately dialyzed for not more than three days. By this method the serum after dialysis contained only an average of 0.12 per cent salt, and it filtered easily through a Seitz filter. In one performance one Seitz filter yielded about 300 cc of filtrate in three to four hours. The serum thus prepared possessed high protective properties and compared favorably in potency with the original unconcentrated serum, as shown by the results of the protection tests already referred to (Table 3). In the first protection test, in which sample II–*a*

TABLE 3.—*Protection tests performed intravenously with controls.*

| Shiga-toxin No. 15 (test dose). | Amount of pure serum. | Mice injected. | First test. |  | Second test. |  | Kind of serum. |
|---|---|---|---|---|---|---|---|
|  |  |  | Living. | Dead. | Living. | Dead. |  |
| *cc.* | *cc.* |  |  |  |  |  |  |
|  | Sample II–*a*: [a] |  |  |  |  |  |  |
| 0.5 | 0.00125 | 2 | 2 | 0 | 2 | 0 | Purified, dialyzed with soda. |
| 0.5 | 0.0025 | 2 | 1 | 1 | 2 | 0 |  |
| 0.5 | 0.005 | 2 | 2 | 0 | 2 | 0 |  |
| 0.5 | 0.015 | 2 | 2 | 0 | 2 | 0 |  |
|  | Sample II–*b*: |  |  |  |  |  |  |
| 0.5 | 0.00125 | 2 | 0 | 2 | ------ | ------ | Purified, dialyzed without soda. |
| 0.5 | 0.0025 | 2 | 2 | 0 | ------ | ------ |  |
| 0.5 | 0.005 | 2 | 2 | 0 | ------ | ------ |  |
| 0.5 | 0.015 | 2 | 2 | 0 | ------ | ------ |  |
|  | Sample (lot 12): |  |  |  |  |  |  |
| 0.5 | 0.00125 | 2 | 2 | 0 | ------ | ------ | Purified, dialyzed with soda. |
| 0.5 | 0.0025 | 2 | 2 | 0 | ------ | ------ |  |
| 0.5 | 0.005 | 2 | 2 | 0 | ------ | ------ |  |
| 0.5 | 0.015 | 2 | 2 | 0 | ------ | ------ |  |
|  | Untreated original sample II: |  |  |  |  |  |  |
| 0.5 | 0.00125 | 2 | 2 | 0 | ------ | ------ | Control serum. |
| 0.5 | 0.0025 | 2 | 2 | 0 | ------ | ------ |  |
| 0.5 | 0.005 | 2 | 2 | 0 | ------ | ------ |  |
| 0.5 | 0.015 | 2 | 2 | 0 | ------ | ------ |  |
|  | Control toxin alone: |  |  |  |  |  |  |
| 0.5 | 0.0 | 6 | 0 | 6 | ------ | ------ | Control toxin. |

[a] **Samples II, II–*a*, and II–*b* were of the same batch of serum.**

serum was used, one of the animals that was injected with 0.0025 cc of purified serum was found dead the day following inoculation. Repeating the same experiment, a series of mice was injected with the same sample II–*a*. The animals in this second test survived and served to check the previous one. No comment will be offered with regard to the results of sample II–*b*, another purified serum dialyzed without soda, until more experiments have been done. All animals used in this experiment were observed for twenty-five days, and the deaths recorded in this report occurred within seven days.

## SUMMARY

A method of purifying antidysenteric serum by the use of sodium sulphate is described. The amount of product recovered by this method is about two-thirds the original volume of plasma or serum. The purified serum is practically free from seroalbumin and compares favorably in immunologic properties with unconcentrated antidysenteric serum.

## ACKNOWLEDGMENT

We sincerely express our gratitude to Dr. Otto Schöbl, former chief of the division of biological products, Bureau of Science, who with Dr. Rita Villaamil started this work that was continued by us. We are also greatly indebted to the division of tests and standards of this bureau for the quantitative determination of sodium sulphate in our purified serum samples.

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# ILLUSTRATION

## PLATE 1

An ice box. *1*, Zinc receptacle where the ice is placed; *2*, tube for the flow of melted ice into the tank; *3*, dialyzing tank; *4*, dialyzing bag in operation; *5*, faucet for adjusting the temperature and the outflow of water; *6*, sack containing thymol. Dimensions of the ice box: Length, 117 cm; width, 80 cm; height, 102 cm.

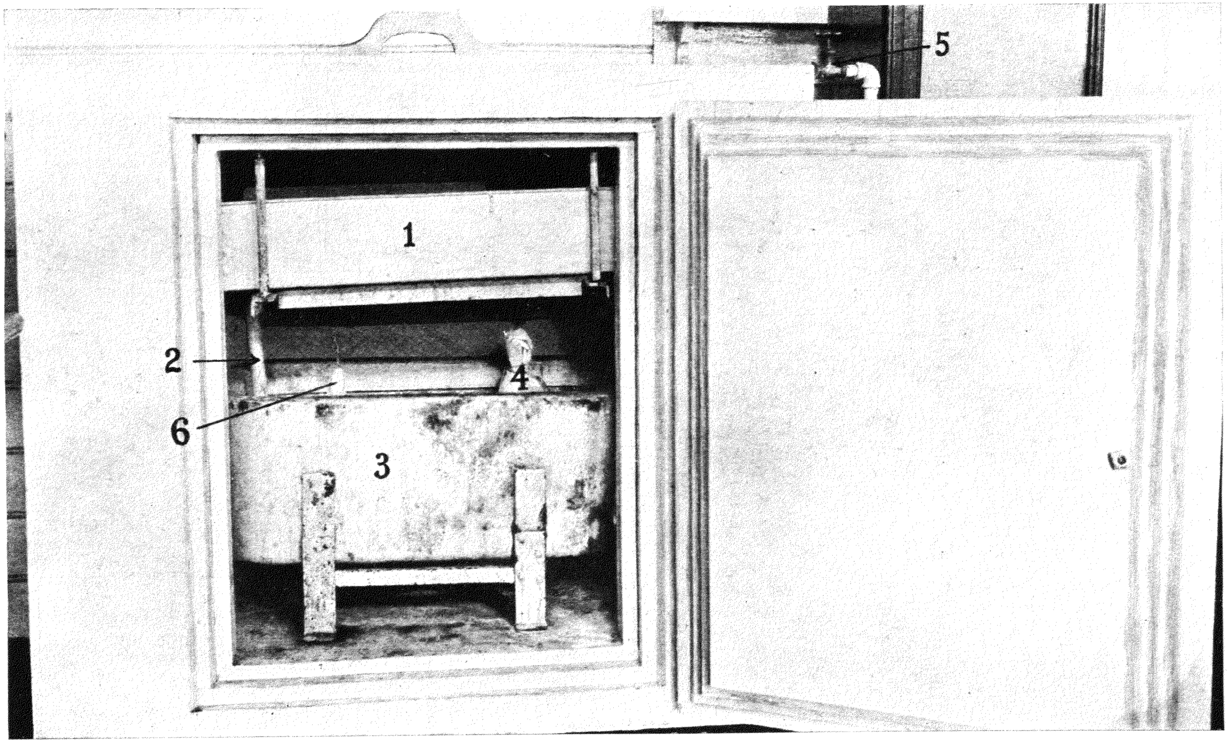

PLATE 1.

# PINEAPPLE YELLOW-SPOT IN THE PHILIPPINES [1]

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FOUR PLATES

## INTRODUCTION

Pineapple yellow-spot is a virosis of pineapple hitherto unreported in the Philippines. It is next in importance to bacterial fruitlet black-rot(8) and mealy-bug wilt(9) and, like the latter two, affects only the Smooth Cayenne variety up to the present. It was first noticed during the middle of 1928, in the trial plantings of the Philippine Packing Corporation in Makar, Cotabato Province, and in Santa Fe, Bukidnon Province. Owing to the characteristic stunting and dwarfing of the severely infected plants, it was at first considered as a bunchy-top disease similar to that of abacá reported by Ocfemia.(7) A careful perusal of its incipient stage has revealed, however, that its most characteristic initial symptom is the unique yellow spotting on the basal part of young leaves, hence, the name "yellow-spot," which appears to be identical with the "yellow-spot" of pineapple in Hawaii, as reported by Illingworth(1) and Linford.(4)

The yellow-spot of pineapple was first reported in Hawaii, in September, 1931, by Illingworth(1) who gives credit to Dr. C. P. Sideris as the investigator to have made in March, 1927, the first studies on the subject which, because of the characteristic rotting of one side of the affected plant, was named "side-rot;" and, to Mr. Glenn E. Paxton, for his suggesting in April, 1929, that side-rot might be a virus disease. Credit belongs to Linford(4) who, in 1931, set forth in a preliminary report his findings that the most important vector, if not the only one, operating in the field occurrence of this disease, is the onion thrips, *Thrips*

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[1] This paper was not submitted for publication as early as desired because of other more pressing phytopathological problems which consumed the writer's full time.

[2] The writer is grateful to the Philippine Packing Corporation for the splendid coöperation extended him in supplying practically all the materials and labor used in the experiments, and to Dr. G. O. Ocfemia, of the Agricultural College, Laguna, for reading the manuscript.

*tabaci* Lindeman. A more detailed account of his report(5) was published in April, 1932.

The origin of this disease in the Philippines is not known. It is quite probable, however, that it was introduced from Hawaii through the importation of infected plant material. This view seems to find support in the fact that yellow-spot is found only among Smooth Cayenne plants imported from Hawaii.

## DESCRIPTION OF THE DISEASE

The disease is manifested first by a slightly raised circular yellowish spot, the so-called "initial spot," on the upper surface of a young tender leaf (Plate 1, fig. 1). It varies in size, ranging from 2 to 15 millimeters in diameter. All the evidence shows that infection takes place somewhere near the base of a very tender leaf, but owing to the continued basal growth its first appearance is usually observed at about 8 centimeters from the base of the leaf in the third or fourth whorl. Ordinarily only one leaf shows the initial spot, although two or more have been observed with the same infection in some instances. Below the initial spot a yellow streak develops after a few days, extending down the base in the form of a water-soaked spot (Plate 1, fig. 2), and under favorable conditions rot soon follows (Plate 1, fig. 3).

In a few days more the yellow streak may show up extending to the leaf immediately above the first affected leaf, thence to all the central leaves. These leaves become stunted, chlorotic, and somewhat brittle and tend to tighten together, while all the lower leaves remain apparently normal (Plate 2, fig. 2). When cut lengthwise, diseased plants reveal patches of browned tissue in the stem around the attachment of the leaf which had the initial spot. At this point the plant evidently ceases to grow and shows a tendency to bend downward, owing to the force of growth of the opposite side (Plate 3).

Infection may take place any time during the life of the plant, although it has been observed more frequently among younger plants. Early infections prevent the plant from normal development, causing stunting, dwarfing, and ultimate death long before maturity (Plate 2, fig. 1). Late infections usually are confined to fruits and crowns. The fruits may be infected through one or more fruitlets of very tender age. This may happen during the blooming period. Infection may start from a flower or a young fruitlet, in the same manner as in a young leaf, or the crown of a young fruit. Malformation, dwarfing, yellowing, and rotting of a few "eyes" of one side of the fruit result from this type of infection, while the opposite side develops normally, forcing the fruit to bend towards the focus of infection. In cases of advanced infection the fruit may become hollow (Plate 4). Such infected fruits resemble in every respect typical specimens of fruits affected by the so-called "Kauai disease" in Hawaii.

All kinds of planting materials have shown susceptibility to infection. It has been observed, however, that suckers are least affected and crowns most. The tightly set leaves of the former in contrast with the loosely set leaves of the latter seem to account for this fact.

## WHAT CAUSES YELLOW-SPOT

The characteristic stunting, dwarfing, and chlorotic nature of the affected leaves make the diagnosis of the disease less difficult. From these symptoms it was believed that the malady is of a virus type. The problem was therefore attacked from this angle, and attempts were made to determine how the disease may be transmitted, whether by mechanical means or by insect vector. Experiments were accordingly carried out on transmission by mechanical means and on transmission by insect vector.

### EXPERIMENT 1

This experiment was conducted October, 1929, in a five-month-old Smooth Cayenne plantation of the Philippine Packing Corporation in Santa Fe, Bukidnon Province. Three methods known to be employed in transmitting virus diseases by mechanical means were tried. The methods were (*a*) by inserting small pieces of diseased parts into slits made on healthy plants, (*b*) by making incision on healthy plants with a scalpel which had been used previously in chopping diseased plants, and (*c*) by needle pricks as described by Wilbrink(10) for transmitting the sugar-cane mosaic by mechanical means.

*Materials and methods.*—The first series of transmission was conducted by cutting with a flamed and cooled scalpel a slit at the center near the base of the three middle leaves of ten healthy plants, and inserting in each slit a crushed piece of an infected leaf. For the control similar slits were made on another set of healthy plants, but crushed pieces of a healthy leaf were inserted in them.

The second series of transmission was carried out by making similar slits with a scalpel on the same number of healthy plants as in the first series, immediately after the scalpel had been used in chopping diseased plants. For the check, similar slits were made on the same number of healthy plants with a flamed and cooled scalpel.

In the third series direct transmission was tried by holding an infected leaf closely against each of the three middle leaves of ten healthy plants and thrusting rapidly ten fair-sized steel needles, mounted at the end of a stick, through the diseased leaf deep enough to prick the healthy leaves. For the control, another set of ten healthy plants was treated similarly but substituting a healthy leaf for the diseased leaf. In every case the surface of the leaves used in the three series was disinfected with 1 : 1,000 mercuric chloride in 70 per cent alcohol and rinsed with sterile distilled water, while the needle was flamed and cooled as in the case of the scalpel.

*Results.*—Each plant in the experiment was observed daily for a month for signs of the disease, but all except three in the last series remained negative even after six months, indicating that the virus of pineapple yellow-spot is not transmissible mechanically by plant extracts. Johnson and Hoggan(2) place pineapple yellow-spot in the category of the viroses that are transmitted by sucking insects and not mechanically by plant extracts. For this reason the three plants in the third series which showed infection probably were infected before they were used in the experiment.

### EXPERIMENT 2

The failure to obtain positive results from the transmission tests by mechanical means suggested that the pineapple yellow-spot virus is transmissible only by an insect vector. Search for this insect vector has revealed the presence of a number of insects such as the pineapple mealy-bugs, springtails, occasionally thrips, etc., both on healthy and diseased pineapple plants. To determine what rôle these insects might play in the transmission of yellow-spot, the following preliminary tests were set out in January, 1930, in a five-month-old Bukidnon Smooth Cayenne plantation of the Philippine Packing Corporation, Santa Fe, Bukidnon Province.

*Materials and methods.*—Ten plants of uniform size and with typical infection of yellow-spot were collected from the ratoon fields at Diklom and Santa Fe, and brought to field 1. The top portion of each plant was cut and meticulously examined for the insect fauna present which was found to be composed of the springtails (*Isotoma* sp.), in adult and larval stages; the pineapple mealy bug (*Pseudococcus brevipes*), in different stages; the onion thrips (*Thrips tabaci*), in larval stage only; and *Tarsonemus ananas*.

Table 1 shows that with the exception of the ninth all plants to which the onion trips (*Thrips tabaci* Lindeman) from infected pineapple had been allowed to migrate became diseased. Some of the plants showed the initial symptoms as early as the second week. All other pineapple plants to which either *Isotoma* sp., *Pseudococcus brevipes*, or *Tarsonemus ananas* were allowed to migrate and colonize remained free from yellow-spot infection. The results seem to indicate that *Thrips tabaci* transmitted the pineapple yellow-spot; but the other insects, particularly the springtail (*Isotoma* sp.) which was present on all the specimens, could not transmit the disease. As the virus of pineapple yellow-spot is one that is biologically carried by *Thrips tabaci* and requires an incubation period of about ten days in the body of the insect vector, the writer believes that the thrips, when used, already had the virus in them for some time. The lone negative result from the transmission experiment with *Thrips tabaci* is perhaps due to the fact that the virus has not yet remained in the body of the insect for the required time of incubation, or else the insects were not viruliferous. Kunkel(3) states that *Thrips tabaci* larvæ can obtain the virus of the yellow-spot but the adults cannot.

TABLE 1.—*Preliminary experiments showing positive results from inoculations with Thrips tabaci.*

| Plant (immature). | Insects present in tops used. | Inoculated. | Observations; 1930. | | | | |
|---|---|---|---|---|---|---|---|
| | | | Jan. 23. | Jan. 30. | Feb. 6. | Feb. 13. | Feb. 20. |
| 1 | *Isotoma* sp.;[a] *Pseudococcus brevipes; Thrips tabaci.* | Jan. 16, 1930 | — | + | + | + | + |
| 2 | -----do----- | -----do----- | — | + | + | + | + |
| 3 | -----do----- | -----do----- | — | — | + | + | + |
| 4 | *Isotoma* sp.; *Tarsonemus ananas.* | -----do----- | — | — | — | — | — |
| 5 | -----do----- | -----do----- | — | — | — | — | — |
| 6 | *Isotoma* sp.; *Pseudococcus brevipes.* | -----do----- | — | — | — | — | — |
| 7 | -----do----- | -----do----- | — | — | — | — | — |
| 8 | *Isotoma* sp.; *Thrips tabaci.* | -----do----- | — | + | + | + | + |
| 9 | -----do----- | -----do----- | — | — | — | — | — |
| 10 | -----do----- | -----do----- | — | — | + | + | + |

[a] Determination by Dr. Fidel del Rosario, entomologist, Bureau of Science.

### EXPERIMENT 3

While experiment 2 was still in progress it was observed that many of the weeds, *Emilia javanica* (Burm. f.) C. B. Rob. and *E. sonchifolia* (Linn.) DC., growing about the old plantations, especially around the ratoon fields, were infected by a certain chlorosis characterized by mottling and circular chlorotic blotches with zonate markings which appeared very similar to, if not identical with, the pineapple yellow-spot. Examination of such plants showed the presence of a number of insects, one of which was the onion thrips, *Thrips tabaci* Lindeman. This observation gave rise to the suspicion that the two viroses are probably identical. To elucidate this matter the following tests were carried out February 21, 1930, in Santa Fe, Bukidnon Province.

*Materials and methods.*—Fifteen uniform Smooth Cayenne crowns, which were obviously free from any kind of spots, were collected from a field where the disease is not known to have occurred. These crowns were trimmed, cured, and dipped fifty minutes in 1.5 per cent soap solution at a temperature of 42° to 43° C. and, after being redried in the sun, each was planted in a gasoline can filled with sterilized soil. The bottoms of the cans were perforated for proper drainage. The cans were then arranged in three groups of five, each group being placed on an insect-proof platform. The platforms were made of bamboos and boards and were provided with cheesecloth covers. To prevent insects from interfering with the experiments, the posts of the platforms were covered with Tanglefoot preparation.

After it has been assured that all of the fifteen plants were free from any disease or pest, three larvæ of *Trips tabaci,* which had previously fed for more than ten days on diseased pineapple plants, were transferred June 1, 1930, to each of the five healthy plants in the first group; while three larvæ of *Thrips tabaci,* which had fed on diseased *Emilia javanica* for the same length of time, were transferred to each of the five healthy plants in the second group, leaving the five healthy plants of the third group free from thrips as check.

The thrips were collected from diseased plants and transferred to healthy plants in the following manner: The rather tight-fitting leaves of the heart or bud of the infected plant were loosened to expose the insects hiding in the spaces between the leaves. With the help of a camel's hair brush moistened with water, the larvæ of *Thrips tabaci* were picked one by one and dropped into a 50-cc beaker with some water to keep them floating. As soon as the required number was collected the water in the beaker was poured into the bud of the plants on which the thrips were to be colonized so that the insects were transferred to the healthy pineapple with the minimum strain. The same method was followed in the case of the thrips from *Emilia javanica*.

*Results.*—Weekly observations for the occurrence of the disease on any of the plants in the experiment are shown in Table 2.

TABLE 2.—*Transmission of pineapple yellow-spot virus by Thrips tabaci.*

| Plant (immature). | Insect. | Inoculated. | Observations; 1930. | | | | |
|---|---|---|---|---|---|---|---|
| | | | June 8. | June 15. | June 22. | June 29. | July 7. |
| 1 | Thrips from pineapple | Jan. 16, 1930 | — | + | + | + | + |
| 2 | do | do | — | + | + | + | + |
| 3 | do | do | — | — | + | + | + |
| 4 | do | do | — | — | + | + | + |
| 5 | do | do | + | + | + | + | + |
| 6 | Thrips from *Emilia* | do | — | — | — | + | + |
| 7 | do | do | + | + | + | + | + |
| 8 | do | do | — | + | + | + | + |
| 9 | do | do | — | — | — | — | — |
| 10 | do | do | — | — | + | + | + |
| 11 | Check (none) | do | — | — | — | — | — |
| 12 | do | do | — | — | — | — | — |
| 13 | do | do | — | — | — | — | — |
| 14 | do | do | — | — | — | — | — |
| 15 | do | do | — | — | — | — | — |

Confirmation of the results obtained from the first inoculation tests (Table 1) that pineapple yellow-spot is caused by a virus transmitted by *Thrips tabaci* may be seen in Table 2. The same table shows that the virus may be transmitted to healthy pineapple either directly from diseased pineapple or from diseased *Emilia* plants. That the pineapple virosis and the *Emilia* virosis are identical, seems a logical deduction from the fact that, when the thrips used in this experiment were transferred to healthy *Emilia* plants, exactly the same characteristic spottings were reproduced on the leaves. The incubation period ranges from seven to twenty-five days as shown by the first symptom appearing in each inoculated plant after the introduction of the infective thrips. The infected plants became dwarfed and died without reaching maturity. These results seem to be more or less in accord with those reported by Linford.(4, 5)

As in Table 1, it is also shown in Table 2 that plant 9 did not become infected and has not shown the slightest sign of the disease even after six months. The reason for this was that the thrips had not been allowed sufficient time on the source of inoculum. The results seem to verify the identity of the Philippine yellow-spot of pineapple with the Hawaiian pineapple yellow-spot.

### YELLOW-SPOT AND "KAUAI DISEASE"

It has been mentioned in the early part of this paper that the pineapple yellow-spot produces a set of symptoms on the fruits very similar to, if not identical with, the symptoms of the so-called "Kauai disease" originally reported in Kauai Island, Hawaii, by Lyon.(6) To determine, therefore, whether the so-called Kauai disease is an after-effect of the yellow-spot or something else, the following test was made.

### EXPERIMENT 4

This experiment was set out July 15, 1930, in field 1 of the Philippine Packing Corporation, Santa Fe, Bukidnon Province.

*Materials and methods.*—Although it was out of season at the time these tests were started, a sufficient number of plants just beginning to bloom were located in three adjoining blocks. Following exactly the same procedure as that used in experiment 3, the blooming plants were used in transmission work by introducing, to each of the first five, three larvæ of *Thrips tabaci*, which had been feeding on diseased pineapple plants for some time; to each of the next five, three larvæ of the same thrips, which had also fed on diseased *Emilia* plants for some time, leaving the last five uninfested as check. This experiment differs fundamentally from the third, however, in the age of the plants when used in transmission work and in the fact that this one was left in the open, while the third was kept in insect-proof cages.

*Results.*—Monthly observations were taken until the fruits reached maturity. The results are given in Table 3.

TABLE 3.—*Effect of yellow-spot virus on young fruits.*

| Plant (immature). | Insect. | Inoculated. | Observations; 1930. | | | | |
|---|---|---|---|---|---|---|---|
| | | | Aug. 15. | Sept. 15. | Oct. 15. | Nov. 15. | Dec. 15. |
| 1 | Thrips from pineapple | July 15, 1930 | — | + | + | + | + |
| 2 | do | do | — | + | + | + | + |
| 3 | do | do | — | — | — | — | — |
| 4 | do | do | — | — | + | + | + |
| 5 | do | do | — | — | + | + | + |
| 6 | Thrips from *Emilia* | do | — | + | + | + | + |
| 7 | do | do | — | — | + | + | + |
| 8 | do | do | — | — | — | — | — |
| 9 | do | do | — | — | — | — | — |
| 10 | do | do | — | + | + | + | + |
| 11 | Check (none) | do | — | — | — | — | — |
| 12 | do | do | — | — | — | — | — |
| 13 | do | do | — | — | — | — | — |
| 14 | do | do | — | — | — | — | — |
| 15 | do | do | — | — | — | — | — |

It is shown in Table 3 that blooming pineapple plants when infested with infective *Thrips tabaci* do not manifest the presence of the yellow-spot virus as early as the younger plants. It takes about two months for the young fruits, which seem to be the focus of attack, to show any manifestation of the disease, in a somewhat different manner. Some of the fruitlets on one side of the infected fruit became constricted and shrunken, while it is readily seen that the other side continued its growth more or less unhampered, forcing the fruit to bend towards the affected side. Further development of the fruit enhanced the bending as well as the rotting of the affected side, so much so, that in some cases the fruit became greatly deformed and hollow (Plate 4, figs. 3 and 4). This has been observed to be of common occurrence in the field. It is very similar to, if not identical with, the so-called Kauai disease in Hawaii. The plant is otherwise normal.

It is also shown in the same table that, as in the previous transmission experiments, some plants were not infected and remained apparently normal. The failure to transmit the yellow-spot in these cases is attributed to insufficient time allowed the virus to remain in the body of the vector. In some cases it was possibly due to the fact that the insect vectors died before they caused the transfer of the virus.

## CONTROL MEASURES

For the present only tentative control measures are recommended. Inasmuch as it has been established that the insect vector lives on weeds like the *Emilia* plants, clean culture is of prime importance. Spraying the infected plants with nicotine-soap solution (0.5 per cent soap and 0.1 per cent nicotine sulphate) to get rid of the thrips may help in minimizing the source of infection and spread of the virus. Dusting with nicotine preparations (tobacco dusts) to keep the thrips away from the young leaves may prove beneficial.

## SUMMARY

1. A disease of pineapple, next in importance to mealy-bug wilt and bacterial fruitlet black-rot, is described. It is a virosis known in Hawaii as the pineapple yellow-spot. So far it affects only the Smooth Cayenne variety, in the Philippines.
2. Early infection causes stunting, dwarfing, and the ultimate death of young plants. With mature plants it produces malformation and rotting of some fruitlets on one side of the fruit which may become hollow, as well as the stunting and dwarfing of the crowns. This condition greatly resembles the so-called "Kauai disease" in Hawaii.
3. Evidence has shown that the disease is a virosis transmitted only by the insect vector *Thrips tabaci* Lindeman and not by mechanical means. Transmission may be effected by *Thrips tabaci* from either diseased pineapple or diseased *Emilia* plants, provided the insects had been allowed to feed on the source of inoculum for more than ten days. The incubation period of the virus in the pineapple ranges from seven to twenty-five days.
4. Tentative control measures are given which, if followed, would help the growers to minimize the ravages of the disease.

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# ILLUSTRATIONS

## PLATE 1

FIG. 1. A young Smooth Cayenne leaf showing early symptom (initial spot) of yellow-spot disease. Note the characteristic circular yellow spot with yellow streak below it. × 1.

2. The same as fig. 1 but far advanced. Note yellow streak below the spot ending in a water-soaked brownish streak at the base of the leaf. × 1.

3. Later stage of the initial spot. Note rotting, chlorosis, and necrosis, with concentric ring or zonate resulting from infection. × 1. (Drawings by the artists, National Museum Division.)

## PLATE 2

FIG. 1. Six-month-old Smooth Cayenne grown from a crown, showing early yellow-spot infection. Note stunting and dwarfing of all the leaves. Infection may have set in before the crown was planted. × 1/3.

2. Six-month-old Smooth Cayenne grown from a crown, showing later infection. Note stunting and dwarfing of the central leaves in contrast with the lower apparently normal leaves. This signifies that infection took place at a later date. × 1/3. (Photographs by C. S. Angbengco.)

## PLATE 3

As in Plate 2, cut lengthwise to show browned patches in the stem around the attachment of the leaf which had the initial spot. × 1/3. (Photographs by C. S. Angbengco.)

## PLATE 4

FIG. 1. A mature Smooth Cayenne fruit showing the effect of yellow-spot infection. Note stunted, shrunken fruitlets ("eyes") at the point of infection. × 0.5.

2. Fig. 1 cut lengthwise to show partly rotten tissues of browned fruitlets. × 0.5.

3. A mature Smooth Cayenne fruit showing the effect of yellow-spot infection in advanced stage. Note rotting fruitlets, forming a hollow. × 0.5.

4. Fig. 3 cut lengthwise to show cavity resulting from rotting tissues of the infected fruitlets. × 0.5. (Drawings by the artists, National Museum Division.)

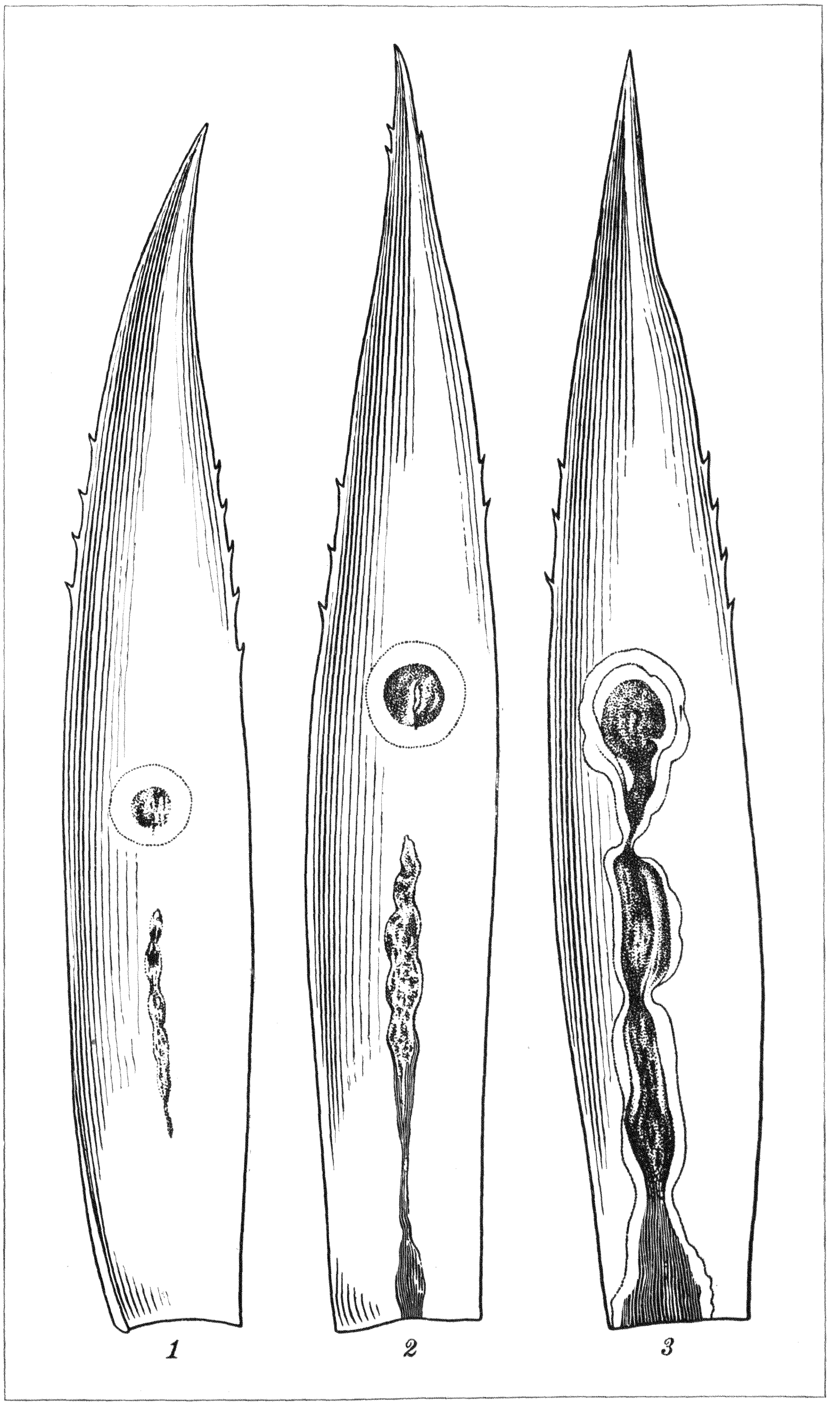

PLATE 1.

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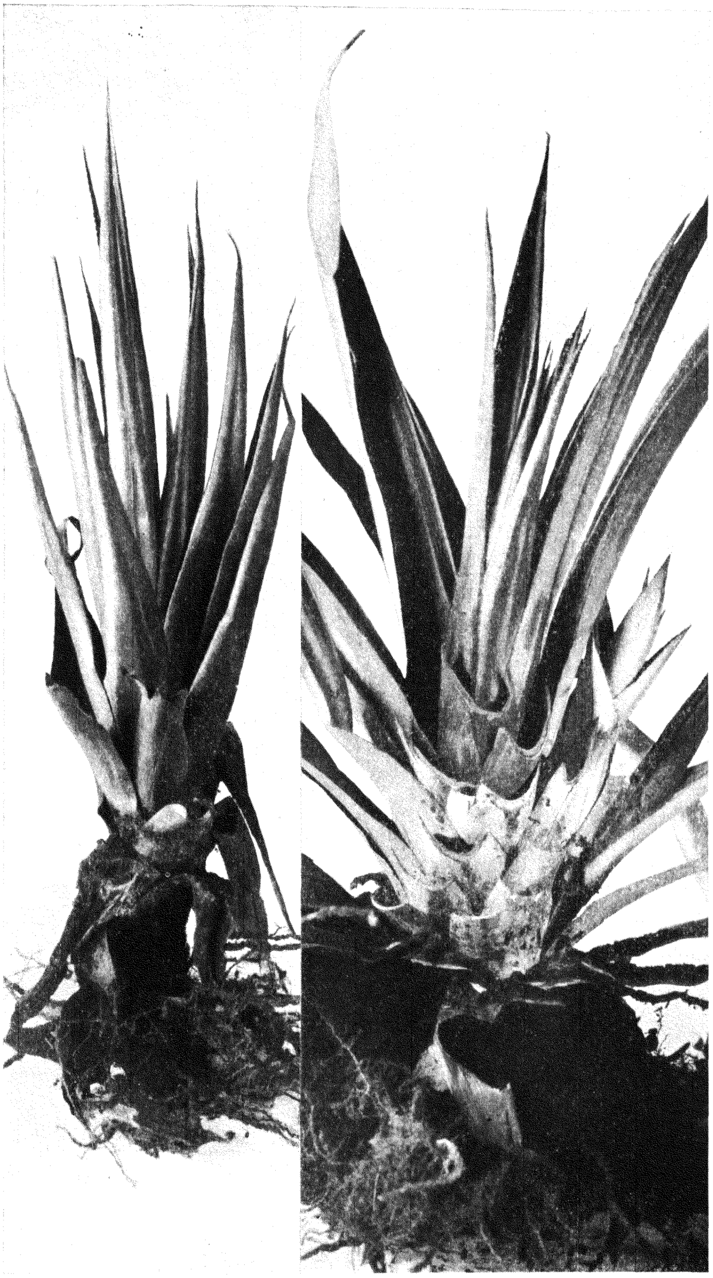

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PLATE 2.

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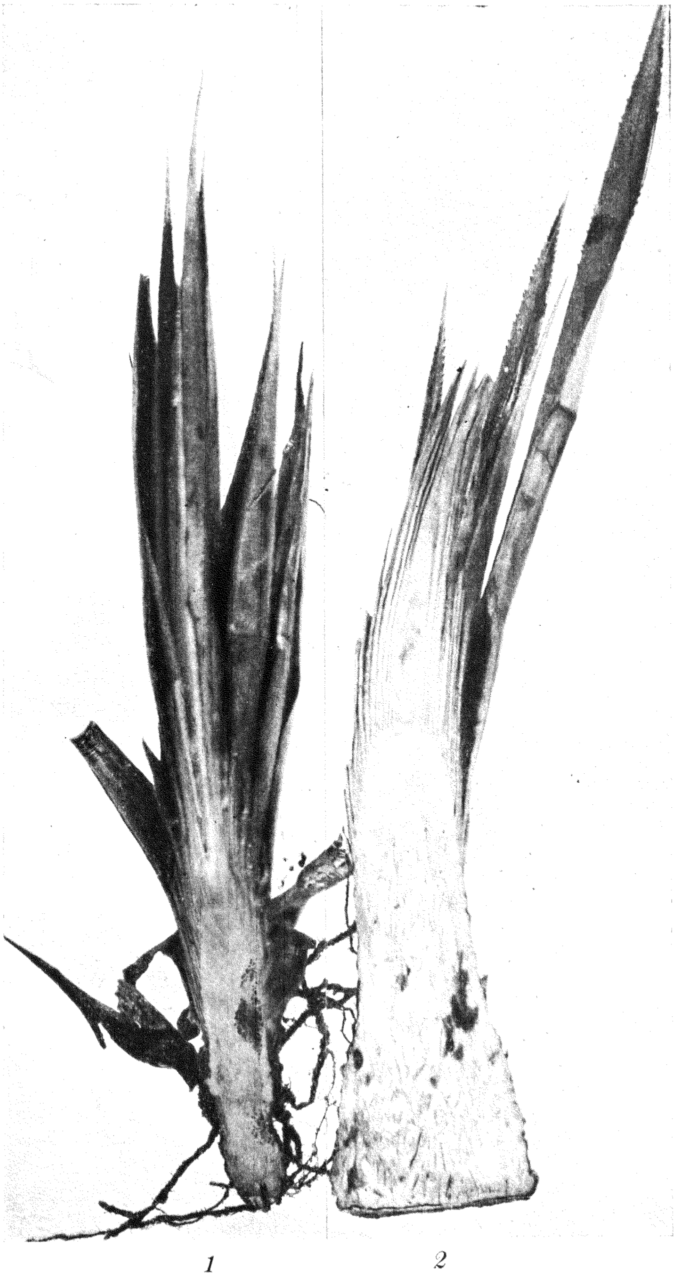

PLATE 3.

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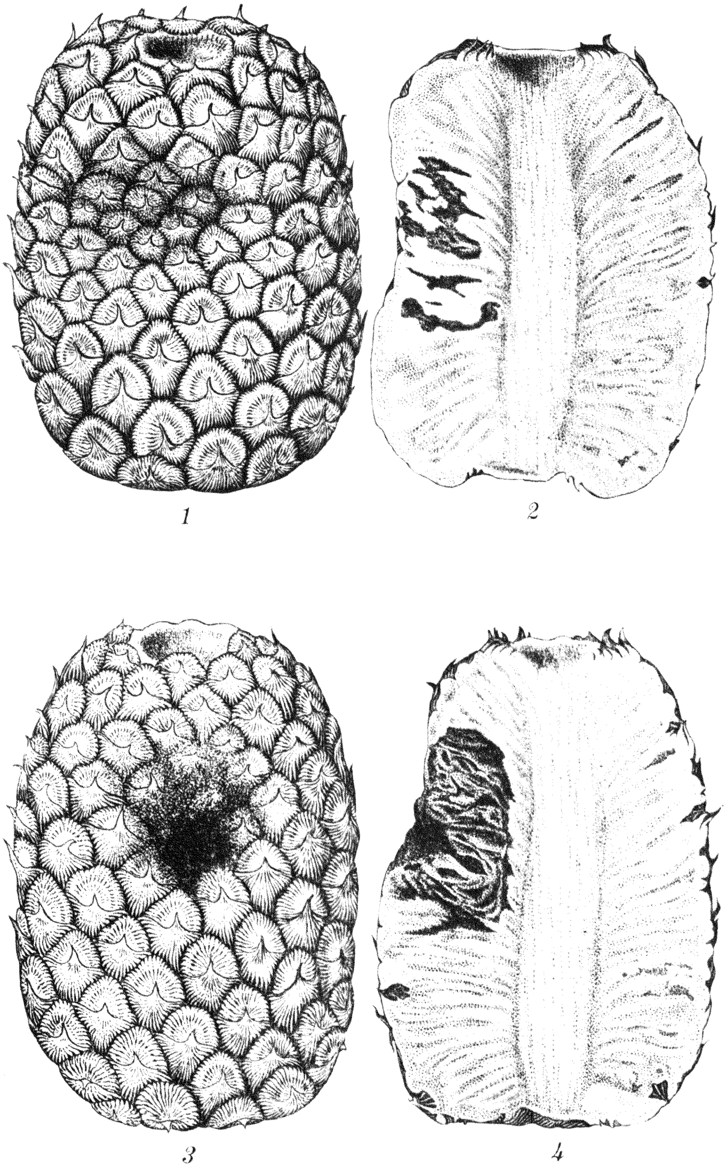

PLATE 4.

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# THREE POISONOUS PHILIPPINE MUSHROOMS

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and

Simeona Leus-Palo

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THREE PLATES

In this paper three poisonous mushrooms are described; namely, *Amanita muscaria* Fr., a deadly poisonous mushroom not heretofore reported in the Philippines; *Lepiota cepaestipes* Fr., a species recently found and tested as poisonous in the Philippines; *Lepiota sulphopenita* Graff, which has been reported previously, but recently found poisonous.

Every year, during the mushroom season, cases of mushroom poisoning are reported in the newspapers, but undoubtedly there have been many other cases that have never been brought to the attention of the public. The number of poisonous species is comparatively small, yet only very few are known or tried by the people. While some may prove poisonous to some persons, they may prove edible to others. Also a particular species of mushroom may be edible in one country, suspected to be poisonous in another, and known to be poisonous elsewhere. It is the purpose of this paper to report and describe not only the edible mushrooms[1] that are newly found in the Philippines, but also those that are known to be poisonous or suspected to be so.

### AMANITA MUSCARIA Fr. (Deadly poisonous.) Plate 1.

*Amanita muscaria* Fr. in Syst. Myc. 1 (1821) 16; Saccardo, Syl. Fung. 5 (1887) 13; Atkinson, Mushrooms (1911) 52–54; Kauffman, Agaricaceae of Michigan 1 (1918) 610–611; Ramsbottom, A Handbook of Larger British Fungi (1923) 25–26; McDougall, Mushrooms (1925) 55; Bresadola, Iconographia Mycologica 1 (1927) 8–9; Swanton, Fungi and How to Know Them (1932) 180.

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[1] Mendoza, J. M., and S. Leus-Palo, Philip. Journ. Sci. 53 (1934) 223–227.

Pileus[2] at first ovate to nearly hemispherical, when expanded convex, becoming flat in age, 8 to 15 centimeters broad; margin striated at maturity; surface viscid and moist when young, yellow, sometimes orange, rarely whitish, covered with numerous scattered rather compact whitish or pale yellowish scales or warts. Gills free, crowded, white to yellowish, broadest toward the margin. Stipe cylindrical or tapering, bulbous at the base, stuffed when young, becoming hollow in age, white or with yellow tinge, covered with loose and floccose scales. Annulus white and very fragile. Volva much torn in the form of concentric scales or interrupted rings surrounding the lower part of the stem and the bulbous base. Spores subglobose or broadly oval, hyaline, smooth-walled, 8.10 to 9.60 μ long, 6.30 to 7.50 μ broad; average 8.70 μ long, 6.70 μ broad. The flesh is white, tasteless, and odorless. This mushroom grows on the ground, singly or scattered in small groups.

LUZON, Mountain Province, Baguio, *Phil. Nat. Herb. 2161 W. H. Brown,* June, 1933, on the ground; *Bur. Sci. 55683, 55778 W. H. Brown,* June 12, 1933, on the ground.

Examined specimens were compared with a United States collection of C. L. Shear, Bureau of Plant Industry, pathological and mycological collections, No. 66879.

This mushroom is deadly poisonous. It grows in the Philippines in cool moist places in high altitudes. It is quite common in Baguio, Mountain Province and vicinity. In the United States and some European countries the infusion of this mushroom is used as fly poison, hence it is commonly called fly agaric in those countries.

### LEPIOTA CEPAESTIPES Fr. (Poisonous.) Plate 2.

*Lepiota cepaestipes* FR., Epicrisis (1836) 38; SACCARDO, Syl. Fung. 5 (1887) 43; KAUFFMAN, Agaricaceae of Michigan 1 (1918) 640; RAMSBOTTOM, Handbook of the Larger British Fungi (1923) 30.

Pileous 3 to 9 centimeters broad, white or yellowish, mealy or covered with yellowish, floccose or wartlike scales, umbonate, oval then campanulate-expanded, obtuse, soft, striate on the margin and splitting in age. Stem white, pale brown in the early part or late in the mushroom season, otherwise the same color as the cap, base bulbous, somewhat ventricose, tapering upward and occasionally covered with floccose particles, hollow,

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[2] The following descriptions are based on fresh full-grown specimens collected during the mushroom season.

5 to 14 centimeters long, 5 to 8 millimeters thick at the apex. Annulus narrow, thin, membranaceous, subpersistent. Gills free, thin, white, narrow, at length remote, edge pruinose. Spores elliptic to ovate, colorless, granular, guttulate, smooth-walled, varying in size from 8.40 to 12.0 μ long, 6.0 to 9.0 μ broad; average 10.0 μ long, 7.0 μ broad. Basidia clavate, 29.0 to 46.0 μ long, 11.4 to 13.5 μ broad; average 30.7 μ long, 12.7 μ broad.

Cæspitose. On decayed leaves under trees and very common during the wet season, from May or April, sometimes up to February when the rainy season is long.

LUZON, Tayabas Province, Atimonan, *Bur. Sci. 55105, 55144 J. M. Mendoza,* June 22, 1933, on the ground: Manila, *Phil. Nat. Herb. 919 Jesus Conosa,* January 15, 1934, on the ground; *Bur. Sci. 50495 S. Leus,* June 21, 1928, on the ground; *Bur. Sci. 50496 B. Reyes,* August 19, 1928, on the ground; *Bur. Sci. 55056 J. M. Mendoza,* July 8, 1933, on the ground; *Bur. Sci. 55117 J. M. Mendoza,* August 1, 1933, on the ground; *Bur. Sci. 55121 J. M. Mendoza,* July 22, 1933, on the ground; *Bur. Sci. 55122, 55123, 55127 P. S. Gener,* September 20, 1933, on the ground; *Bur. Sci. 55135, 55142 J. M. Mendoza,* July 7, 1933, on the ground; *Bur. Sci. 55147 J. M. Mendoza,* June 29, 1933, on the ground; *Bur. Sci. 55148 J. M. Mendoza,* July 11, 1933, on the ground; *Bur. Sci. 55157, 55158, 55161 J. M. Mendoza,* July 11, 1933, on the ground; *Bur. Sci. 55207 J. M. Mendoza,* July 26, 1933, on the ground; *Bur. Sci. 55296 D. Farol,* June 3, 1933, on the ground; *Bur. Sci. 55302 J. M. Mendoza,* June 3, 1933, on the ground; *Bur. Sci. 55611 J. M. Mendoza,* June 19, 1933, on the ground; *Bur. Sci. 55770 P. S. Gener,* November 8, 1933, on the ground; *Bur. Sci. 55771 P. S. Gener,* November 7, 1933, on the ground; *Bur. Sci. 55824 P. S. Gener,* October 13, 1934, on the ground; Rizal Province, Pasay, *Bur. Sci. 55553 J. M. Mendoza,* May 20, 1933, on the ground; *Bur. Sci. 55146 J. M. Mendoza,* July 7, 1933, on the ground; *Bur. Sci. 55151 J. M. Mendoza,* July 29, 1933, on the ground.

This mushroom is one of the most resistant to drought. During the mushroom season it is one of the first and last to be seen appearing in shady places, especially under acacia [*Samanea saman* (Jacq.) Merr.] trees where semidecayed leaves and other organic matter are thickly piled in heaps. It often grows in large quantities, forming a large mat. The features of this fungus are very variable, especially the size and color shading. In the early and late parts of the rainy season this mushroom is much smaller than the normal size. The stem is chestnut on the lower portion, becoming paler to almost white toward the gills. The stem at this time is slightly winding and the texture is hard. The pileus is also pale chestnut at the upper central portion, becoming much paler to white toward the margin. It is thinner and much narrower than the average-sized cap.

This mushroom is poisonous, specially when a large quantity is eaten. Tests have been made as to its edibility. For the first time four pieces of the average size were cooked together with a very little lard, pieces of garlic, onion, ginger, and dried salted fish (*tinapá*). The prepared dish was eaten by the author together with the regular noon meal in the laboratory. The taste was excellent and the same as that of *Lepiota americana,*[3] which is delicious and a little peppery. Encouraged by the result of the first test and because of the delicacy of the dish, the senior author took home about a dozen mushrooms of this species and cooked them in the same way as before. Four persons, besides the author and his family, ate the mushroom dish together with other food for supper. It was delicious as before and nothing happened. The next day a matlike form of this mushroom was found growing under the acacia trees in the ground of the Bureau of Science. These were collected and a regular-sized paper bag full of them was taken home for supper. The cook cleaned the mushrooms at once and washed them well with water. They were torn into pieces of the desired size and cooked as before. A small quantity of the soup of salted fish (*bagong*) was also added later when the mushrooms were almost cooked. Four persons, besides the senior author, and two members of the family partook of the mushroom dish. The portions, however, taken by them were not the same in amount. The cook, his wife, and a maid took the largest ration, while the rest of us took but very little of the dish. About half an hour after supper, three of the persons who ate the biggest portion, began complaining of slight pain in the stomach, accompanied by dizziness. Soon they began vomiting continuously, until every bit of the mushroom was completely discharged from the stomach. No diarrhœa was observed among the victims. Nothing happened to the fourth person who ate a less amount, nor to the rest of us who took but very little of the mushroom dish. The victims became weak and perspired profusely. When vomiting was over, they lay down quietly and went to sleep. A doctor was consulted, and an emetic was prescribed. The medicine was no longer taken, for it was thought to be unnecessary.

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[3] Mendoza, J. M., and S. Leus-Palo, Philip. Journ. Sci. 52 (1934) 223–227.

The incident proved beyond doubt that *Lepiota cepaestipes* is poisonous, especially when a large amount is eaten. When taken in small quantities, however, no poisonous effects were observed.

This mushroom is known to be edible in the United States, while in England [4] it is suspected of being poisonous. The same is true of some other species of mushroom; for example, *Volvaria speciosa* is considered poisonous in Europe, whereas in California [5] it is eaten and considered perfectly safe.

An interesting habit of this mushroom is the formation of a fairy ring about 2 meters in diameter. The ring was found on green grass, in Atimonan, Tayabas, in June, 1933. This was the first incidence of the formation of a fairy ring by this particular mushroom ever reported in the Philippines or elsewhere.

**LEPIOTA SULPHOPENITA Graff. (Poisonous.) Plate 3.**

*Lepiota sulphopenita* GRAFF, Philip. Journ. Sci. **9** (1914) 245.

Pileus globose to conical when young, becoming campanulate to broadly expanded, generally sulphur yellow throughout, sometimes the center of the cap is nearly orange, covered with fine floccose scales which disappear in age, thin, fleshy, 4 to 7 centimeters broad; margin deeply striated, specially when old. Gills free, thin, narrow, few, white, becoming yellowish because of the scales from the cap that adhere to them. Stem hollow, floccose, cylindrical, bulbous and elongated at the base, sulphur yellow, 7 to 10 centimeters long, 6 to 11 millimeters broad. Annulus thin, and early disappearing. Spores ovate-elliptic, colorless, guttulate, smooth-walled, 7.5 to 9.6 μ long, 5.4 to 6.3 μ broad. Basidia clavate, granular, 15 to 18.6 μ long, 3.6 to 4.5 μ broad.

The flesh is yellow. The plants grow solitary or gathered in tufts of a few.

LUZON, Manila, *Phil. Nat. Herb. 1283 P. S. Gener,* May 28, 1934, on the ground; *Phil. Nat. Herb. 1345 P. S. Gener,* May

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[4] Ramsbottom, John, A Handbook of the Larger British Fungi (1923) 30.

[5] McDougall, Mushrooms (1925) 62.

23, 1934, on the ground; *Merrill 8417* (type in the Phil. Nat. Herb.), August 18, 1912; *Bur. Sci. 55825 J. M. Mendoza,* August 31, 1933, on the ground; *Bur. Sci. 55826 P. S. Gener,* October 8, 1933, on the ground: Rizal Province, Pasay, *Phil. Nat. Herb. 1547 Bureau of Health employee,* May 23, 1934, on the ground.

A batch of this mushroom was sent by the Bureau of Health to the Bureau of Science for determination. According to the investigation conducted by the Bureau of Health officer, this mushroom was the cause of poisoning of four persons in Pasay, May, 1934; one of them, a child, died.

# ILLUSTRATIONS

## PLATE 1

FIG. 1. *Amanita muscaria* Fr., × 0.6.

2. *Amanita muscaria* Fr., a section of the gill; photomicrograph showing the hymenium with basidia and spores; × 235.

## PLATE 2

FIG. 1. *Lepiota cepaestipes* Fr., in natural habitat, showing different stages.

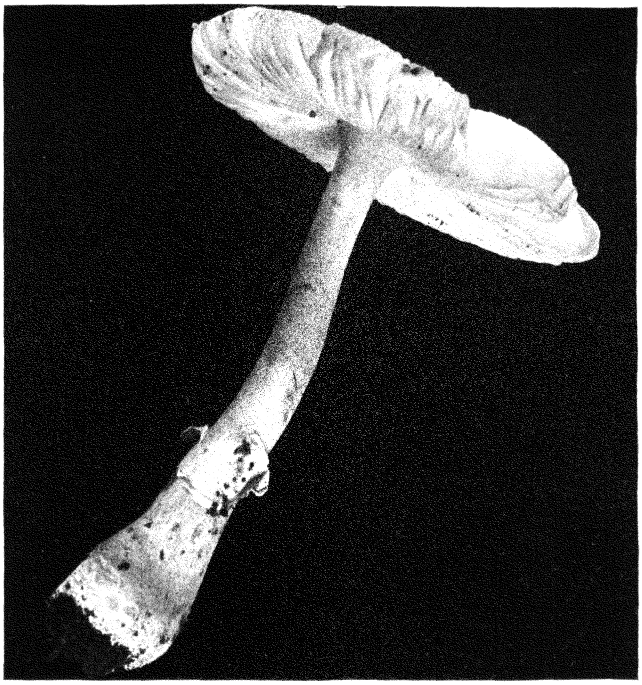
2. *Lepiota cepaestipes* Fr., a section of the gill; photomicrograph showing the hymenium with basidia and spores; × 235.

3. *Lepiota cepaestipes* Fr., forming a fairy ring.

## PLATE 3

FIG. 1. *Lepiota sulphopenita* Graff, showing various stages.

2. *Lepiota sulphopenita* Graff, a photomicrograph of the spores from spore collection, × 433.



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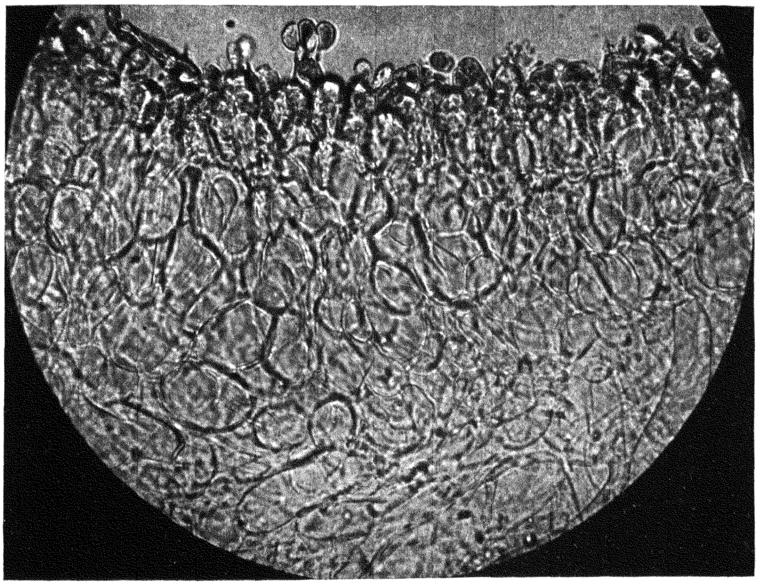

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PLATE 1.

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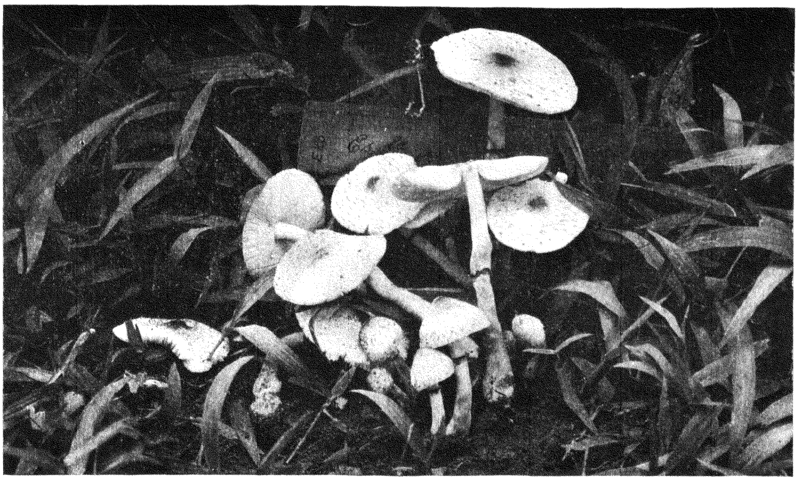

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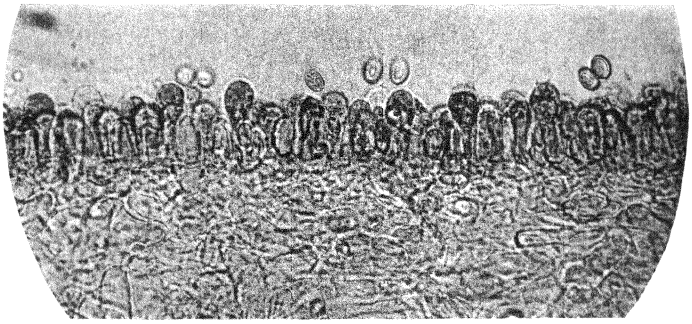

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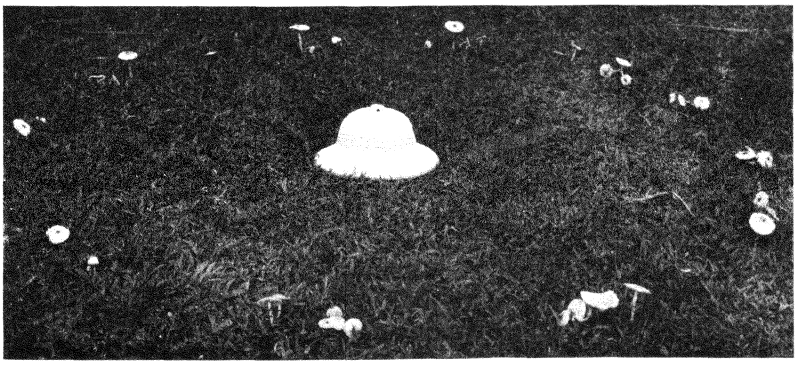

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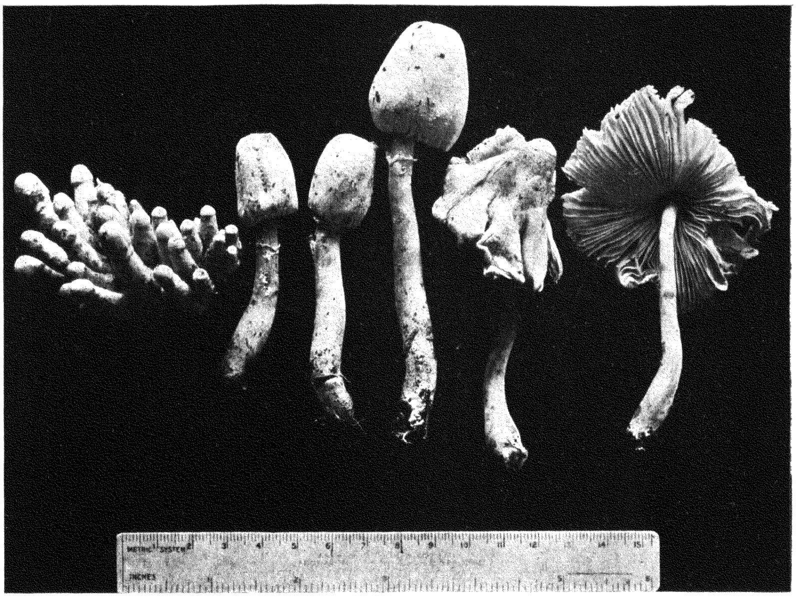

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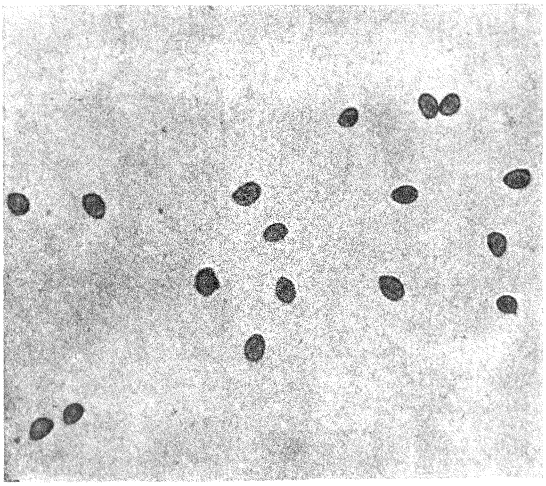

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PLATE 3.

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# ETHNOGRAPHIC NOTES ON THE ISINAIS OF NUEVA VIZCAYA

By Ricardo E. Galang

*Of the National Museum Division, Bureau of Science, Manila*

THREE PLATES

Of the minor Christian groups in the Philippines, the Isinais, or Ituyes, are one of the least known. They are made up of converts from the lowland group of people of uncertain origin having the same characteristics as the Pangasinanes, and intermarried with the Igorots.

## ORIGIN

The name Isinai was given to this group by the Italones, Ilongots, or Ibilaos, who occupy the headwaters of Cagayan River in Nueva Vizcaya Province, Luzon. Pardo de Tavera says that the etymology of the word *Isinai* seems not very clear. *Sina,* in the Iloko dialect means "segregation, or separation, of persons;" the word seems acceptable as root of the name of the tribe, when one considers, for example, that the name Ilongot is formed from the word *longot,* which in the Iloko dialect means "reunion, or aggregation, of persons."

> Su etimología no me parece muy clara; *sina,* en ilocano significa "segregación, separación de personas", voz que me parece aceptable como radical de este nombre de tribu, cuando se considera que otra de ellas llamada *ilongot* está formada de la palabra *longot,* que en ilocano quiere decir "reunión, conjunto, agregación de personas."[1]

## GEOGRAPHIC DISTRIBUTION

At present the Isinais are confined to the three mountain towns of Aritao, Bambang, and Dupax in Nueva Vizcaya Province, north-central Luzon. These three towns were established about the middle of the eighteenth century. Aritao was established in 1740 with 984 inhabitants, Bambang in 1747 with 3,639 inhabitants, and Dupax in 1740 with 2,489 inhabitants.

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[1] Pardo de Tavera, T. H., Etimologia de los Nombres de Razas de Filipinas. Manila (1901) 13.

## ORIGIN OF THE NAME OF EACH TOWN

Aritao derives from the word *hari-tao,* meaning "our king." It is said that there was a strong *Igolot* (Igorot) living on the top of Bona Mountain near Aritao. He was persuaded by the Spanish missionaries to come down to the lowland so that he could be Christianized. He finally consented on condition that the place he selected for his home in the lowland be filled with earth from the top of the mountain where he was living and that his house be transferred to the lowland. As he was very strong the people of the lowland were afraid of him. They call him "Aritao."

Bambang means "a hole dug in the ground." Formerly there were two clans in the town of Bambang, who were constantly at war against each other. At last they realized the great number of casualties in both clans and came to an agreement to settle their differences. They buried their weapons in a big hole (bambang) as a sign of peace.

Dupax derives from the Isinai word *dupa,* meaning "to rest or recline." The town was formerly a famous hunting place for deer. There were two native chiefs, who went to hunt deer in that place; after hunting, they use to take a rest there.

## POPULATION

Once the Isinais were numerous and occupied several areas in Nueva Vizcaya Province. Now they are fast disappearing due to intermarriage with Ilocano settlers, particularly those living in the town of Aritao and Bambang. In Dupax, however, there are still many pure Isinais. Their estimated number is over 2,000.

## PHYSICAL TYPE

The Isinais are predominantly of the Malay blend, with a very high percentage of the short Mongol type. There is probably also some Ainu admixture.[2]

## CULTURE

Formerly the Isinai culture showed some relationship with that of the Ifugaos and of the Ibaloi group of the Igorots.[3] Now much of the general Spanish-Filipino culture prevails.

---

[2] Beyer, H. Otley, Population of the Philippine Islands in 1916. Manila (1917) 48.

[3] Beyer, H. Otley, op. cit. (1917) 48–49.

## ECONOMIC LIFE

*Agriculture.*—The Isinais practice irrigated agriculture. Their principal products are rice, cotton, tobacco, and coconuts.

*Hunting and fishing.*—Hunting and fishing are carried on to some extent. Nets and traps are employed for catching fish. The fish traps are unique. Those used for catching murrels are called *bangcat* and are provided with rattan spines inside. Those used for catching small fish are called *apayao.*

*Basketry.*—The Isinais do some basket work. The materials commonly used are rattan and nito. Two types of weave are employed; namely, twilling, or sawali weave, and coiling. The traveling baskets, which are called *pasiquing,* are similar to those of the Ilocanos, and the Ifugaos and other pagan groups of northern Luzon.

*Weaving.*—The Isinais do excellent weaving. They employ "the tie and dye process" on warp similar to that of the Mandayas and Bagobos of Mindanao. The designs are unique and characteristic. They are usually the highly conventionalized forms of human figures, animals, and other objects. These designs are seen particularly on their *ues pinutuan* (blankets) and *indong* (G strings). Stripes of red and yellow or red and black are employed on their *caray* (traveling bags).

*Transportation.*—The Isinai methods of transportation are primitive. Sleds and carts drawn by carabaos or cattle are used to transport products from one place to another. Horses are also in common use on mountain trails.

*Housing.*—The Isinai house is a structure of wood with a thatched roof. The floor is raised from four to six feet above the ground. The date of the construction of the house is usually carved on the ridgepole. The piled stone fence around the house, which is about one meter high in the form of a trench, is common throughout the three Isinai towns. The stones are obtained from shallow streams nearby.

*Dress.*—The typical hat of the Isinais is the *taddung* or a round hat made of *dap-dap* wood (*Erythrina variegata*). Their dress is similar to that of other Christian Filipinos. The ordinary clothing of the men is the shirt and trousers; the women wear *camisa* and skirt.

## SOCIAL LIFE

*Dances.*—The typical dances of the Isinais, which are held on festive occasions, are four; namely *investida, induma, in España,* or *itaquero,* and *aninó.* Each of these dances requires a man and a woman. In the investida the dancers do not hold each other, and the movements of the hands follow the rhythm of a particular music. In the induma the movements of the feet emphasize the rhythm of a particular music. In the in España, or itaquero, the dancers one after the other recite some melancholy verses as a sort of poetical joust. The aninó is danced to the accompaniment of a guitar. The dancers recite some verses, which are a sort of advice to the newly married couple.

*Marriage customs.*—Formerly it was customary for the parents to make the arrangements for the marriage of their children; now this matter is left to the boy and the girl. When a boy wants to marry, his parents inform the parents of the girl that they will go to the latter's house at a stated date and hour. This is called *balita.*

Then the parents of the boy, together with a spokesman, inform the girl's parents that the boy and the girl love each other. They provide an artificial heart, which is called *calun* and contains a ring. The boy gives the ring to the girl as a sign of troth. A cup of native wine is also provided, one-half of which is taken by the boy and the other half by the girl. After drinking, both announce before their relatives and friends that they are lucky enough to be future husband and wife.

Then comes the marriage ceremony, which is usually performed in a catholic, a protestant, or an Aglipayan church.

After the wedding, the couple goes to the girl's house where they entertain their relatives and friends. Just after lunch or dinner the newly married couple dances the investida. The relatives and friends of both parties likewise dance and after dancing put their money on the plate for the couple. This is called *paragala.*

The boy does not live or sleep with his wife just after their wedding. On the next day his parents turns him over to the parents of the girl. Only then can they live together as husband and wife.

*Circumcision.*—Like other Christian Filipinos, the Isinais practice circumcision. They split the foreskin with a sharp knife or razor. Young guava leaves are masticated and applied as a medicine. The boys are usually circumcised at the age of 14 to 16. They call this practice *capun.*

*Superstitious beliefs.*—The Isinais believe that sickness is caused by the *anitos.* They offer pigs and chickens to the anitos in order to appease them. The person who finds out the causes of sickness is called *sipu.*

When one loses his way in the forest, it is believed that it is caused by the anitos. The person who loses his way is called *naib-iba.*

*Death.*—When a member of the family dies, his belongings are usually placed in one corner of the house, and ashes are put on the stairs in order to detect if the spirit of the dead has visited them. If they want to see the shadow of the dead, they place a white curtain in the house. The name of the person and the date of his death are usually written on the front wall of the house. As a sign of mourning the women wear black ribbons.

## DIALECT

Of the many minor dialects spoken in the Philippines, which are rapidly becoming extinct due to the encroachment of their strong neighbors, Isinai, or Inmeas, is one of the least known.[4] It is spoken only in the three mountain towns of Aritao, Bambang, and Dupax, Nueva Vizcaya Province. The dialect, although distinct, is related to Iloko.

*The Isinai postpositive article.*—Conant[5] states that the most striking characteristic of the Isinai dialect is its treatment of the definite article. Its forms are the following: *Ar, ardari,* and *war.* Of these forms, *ar,* is both prepositive and postpositive, *ardari* positive only, and *war* prepositive only. All words requiring the definite article take a postpositive, *ar* for the singular and *ardari* for the plural; for example, *tahu,* man; *tahuar,* the man; *tahuardari,* the men. A prepositive, *ar* or *war,* accompanies the postpositive under the following syntatic conditions: *War* is used when the word stands in the relation of subject of a copulative verb, and *ar* when it stands in the relation of predicate. The following example will illustrate both cases: *War Espiritu Santoar ot ar atlunar personas;* The Holy Ghost is the third person. *Ar* and *war* are used for singular and plural alike; for example, *ar* (or *war*) *babayardari,* the women; but they must always be accompanied by the postpositive article. Under all other syntatic conditions, the postpositive article only is used; for example, *namalsat biopar on pio'ar*—made the heaven and earth.

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[4] Conant, Everett Carlos, Journ. Am. Oriental Soc. 35 (1915) 289.

[5] Journ. Am. Oriental Soc. 35 (1915) 291.

*Lexical comparison.*—Some of the commonest terms have been selected to show the affinity of the Isinai dialect to its sister tongue, the Iloko, and to gain thereby an insight into the nature of the features common to both dialects.

*Common terms showing the affinity of the Isinai to the Iloko.*

| English. | Isinai. | Iloko. |
|---|---|---|
| moon | buen | bulan |
| night | labi | rabi-i |
| star | bituon | bittuen |
| lightning | ilat | quimat |
| fire | apoy | apuy |
| water | danum | danum |
| year | taon | tauén |
| flower | tabong | sabong |
| root | lamot | ramut |
| vein | ulat | urat |
| man | tajo | taó |
| father | ama | amá |
| woman | babai | babai |
| mother | ina | ina |
| old man | lacay | lacáy |
| name | ñgaron | nágan |
| head | uyo | ulo |
| lip | subil | bibig |
| tongue | dila | dila |
| eye | mata | mata |
| breast of female | tutu | susú |
| armpit | quere | quili-quili |
| heart | pusu | púso |
| leg | ipuo | luppo |
| nail | uu | cocó |
| finger | am-ama | ramai |
| elbow | sico | sico |
| gall | apdo | apró |
| dog | atu | ásu |
| fish | isira | sidá |
| pig | baboy | babuy |
| goat | canding | calding |
| deer | usa | ugsa |
| house | beyoy | balai |
| food | anon | canen |
| fat | taba | tabá |
| gold | balitu | balitoc |
| hunger | bisil | bisin |
| thirsty | naoao | uáo |
| one | csa | maisa |
| two | dúa | dua |

*Common terms showing the affinity of the Isinai to the Iloko*—Continued

| | | |
|---|---|---|
| three | tio | tal-ló |
| four | upat | up-pát |
| five | lima | lima |
| six | unum | inném |
| seven | pitu | pito |
| eight | ueyo | oalo |
| nine | siyam | siám |
| ten | simpio | sangapulo |
| eleven | simpio ta osa | sangapulo ket maisa |
| twenty | duampio | duapulo |
| one hundred | osan lasut | sangagasut |

# ILLUSTRATIONS

## PLATE 1

FIG. 1. An Isinai house (beyoy). Note the piled stone fence about 1 meter high in front.

2. A typical saddle of the Isinais made of rattan.

## PLATE 2

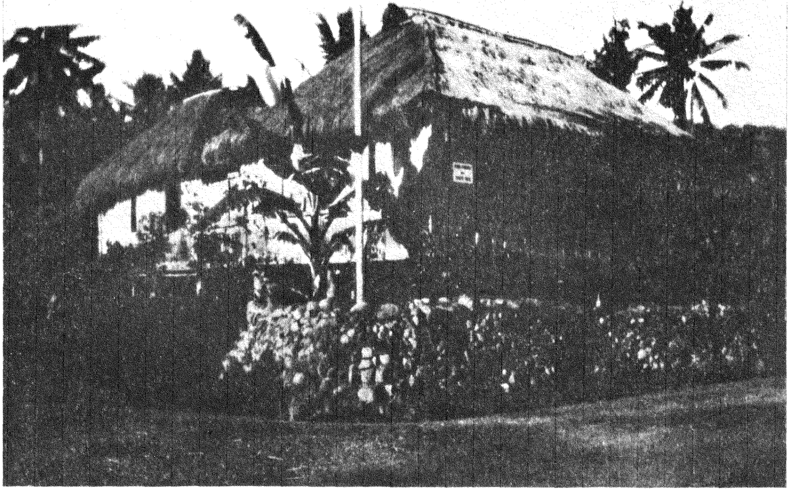
FIG. 1. A fish trap (bangcat) for murrel fish provided with rattan spines inside.

2. A pot lifter made of rattan.

3. A typical blanket (ues pinutuan) of the Isinais woven into "tie and dye" process with realistic designs.

## PLATE 3

Typical Isinai G strings (indong).



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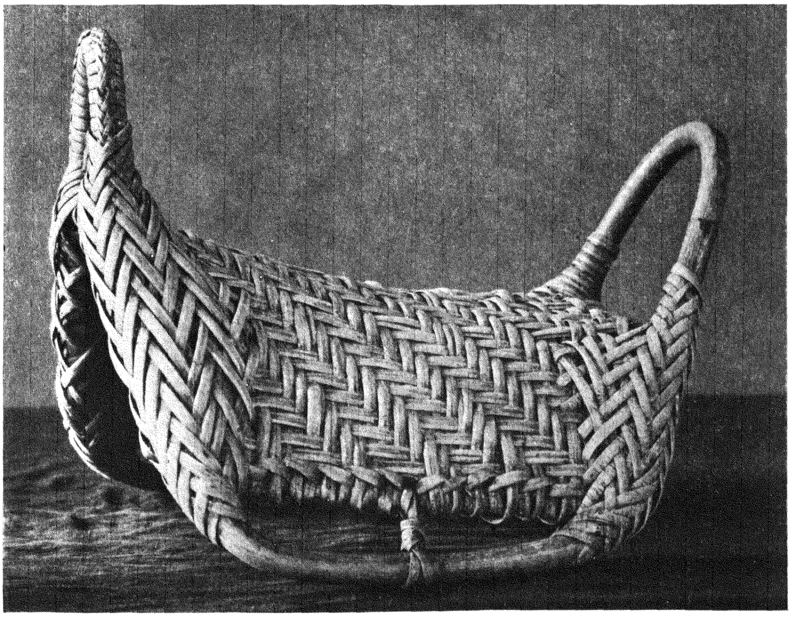

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PLATE 1.

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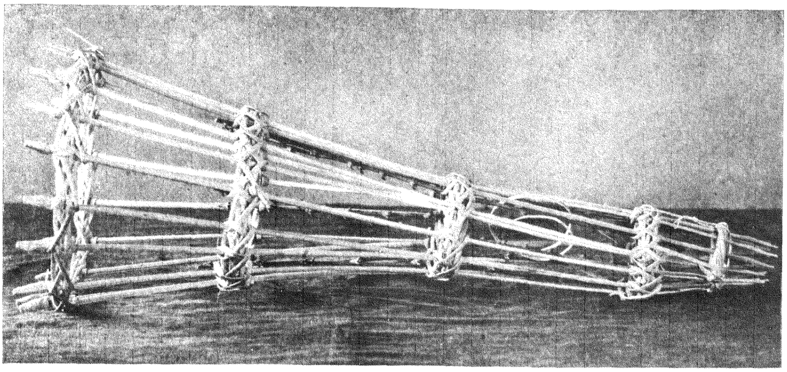

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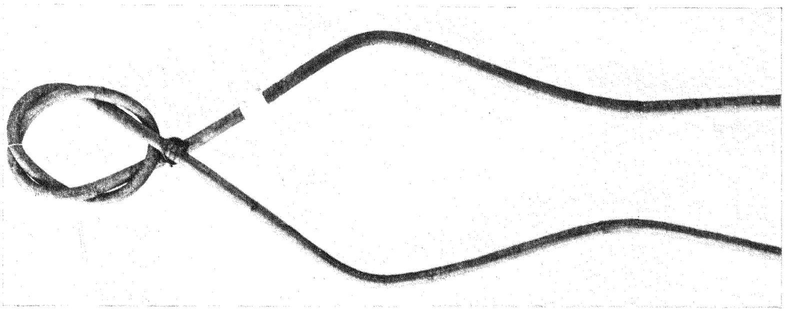

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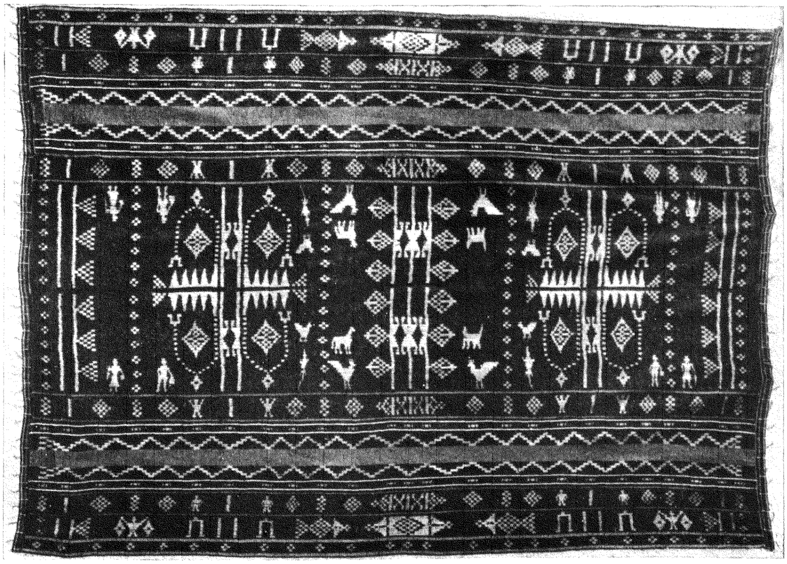

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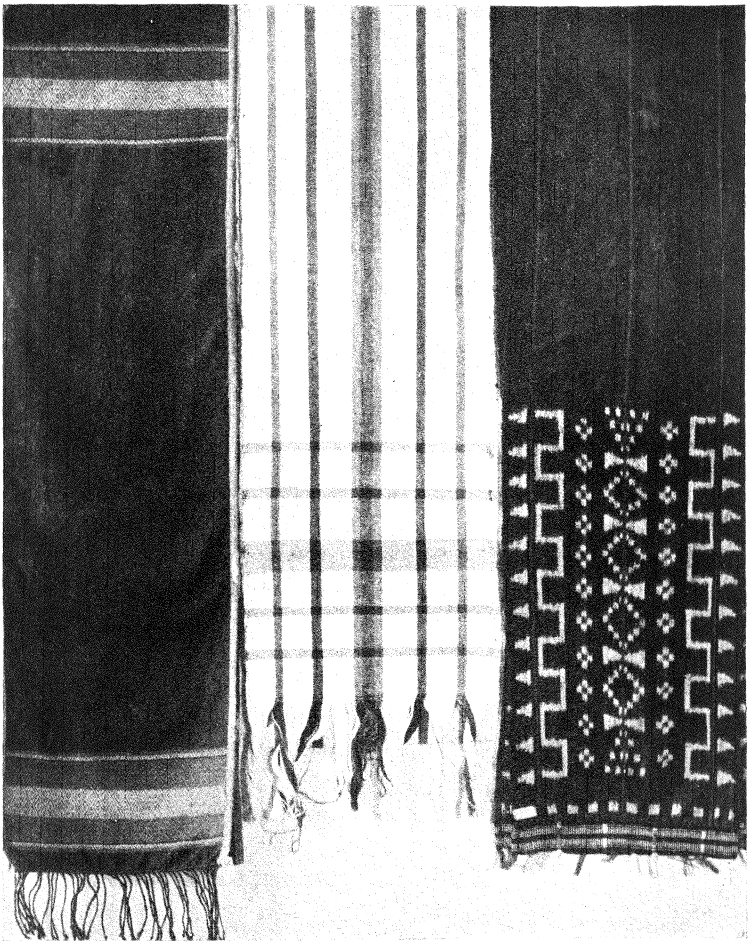

PLATE 3.

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# SOME METHODS OF CIRCUMCISION IN THE PHILIPPINES

By GENEROSO S. MACEDA

*Of the National Museum Division, Bureau of Science, Manila*

TWO PLATES

## INTRODUCTION

"Circumcision" in Latin is *circumcisio,* derived from the Latin verb *circumcidere—circum* (around) plus *caedere* (to cut), meaning "to cut around." It is locally known as *tuli* among the Tagalogs; *turi* or *tulé* among the Visayans; *tulí* among the Pampangos; *coguit* among the Ilocanos; *turi* among the Bikols; *segat* or *capon* among the Pangasinanes; *tuli* among the Sambals; *banguit* among the Yogads; *sugiat* among the Kalingas; and *islam* among the Sulu Moros. It is defined in the Encyclopædia Britannica as the removal of a sufficient portion of the foreskin to allow a free retraction beyond the glans penis. In the Americana it is defined as an amputation of the foreskin or labia minora of the human organs of generation. From the methods practiced in the Philippines there is but one that conforms to the above definition, known as *tuli sa bao.* All other methods may be defined as the lengthwise slitting of the foreskin, or the prepuce of the penis, so as to expose the head of the penis as far as a little behind the corona glandis. The method now employed by many in the Philippines is circumcision in the real sense performed by physicians. It is the removal, or the amputation, of the foreskin of the penis and the suturing at the free borders of the prepuce under local anæsthesia.

## HISTORICAL BACKGROUND

Circumcision is a very generalized ancient custom, and few Filipinos have not undergone the operation. It is an old practice, for the natives have acquired it from many generations before them.

> Some of them, who practiced circumcision, traced its origin not to the Mohametans (inhabitants of Borneo 300 leagues distant) with whom they had no acquaintance, but to their own very remote ancestors.[1]

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[1] Blair, Emma Helen, and James Alexander Robertson. The Philippine Islands 1493–1898 34 (1905) 319.

However, it must not be inferred that this custom has been acquired from the Jews or from the Arabs.

> They had the custom of circumcision, a custom which they did not acquire from the Arabs, since it is still practiced on the peaks of the independent mountains. They practice it still, and that against the will of the curas. Ancient customs have very great force. It is to be noted that the manner of operation is not the same as that practiced by the Jews, for the cut is made from the upper to the lower part.[2]

It is interesting to note also that female circumcision had been in practice together with male circumcision, but due perhaps to the unappreciated advantages that it gives it did not gain ground and had been forgotten.

> Not only do they circumcise the males but also the women, girls, or *dalagas* [an operation] which they call *sonad.* It is reduced to cutting the organ or opening it up somewhat.[3]
>
> At the birth of males and even the females, the midwives themselves made easier for them the carnal act, by cutting off I know not what from their organs.[4]

## METHODS USED

So far there are four generally known methods used; namely, *tuli sa batakan, tuli sa itak, tuli sa gunting,* and *tuli sa bao.* These methods are performed by any man whom the one to be circumcised may request. Preferably, a barber is chosen because of his skill in handling the cutting instruments used, but never a relative of the one to be circumcised is chosen. This operation is done in a very secluded place during the hot season. The boy to be circumcised must be at the age ranging from 8 to 14 depending upon the preputial adhesion. A bath before the operation is required in order to make the cutting of the skin easy.

*Tuli sa batakan.*—The operator provides a polished piece of wood preferably a guava tree branch, carved and flattened at one end. The length is about 1½ ft. One end of it is driven into the ground at the same elevation as that of the penis when the one to be operated squats on his thighs. The foreskin or the prepuce of the penis is then drawn to the flat point of the erected apparatus called the *batakan.* The operator also in a squatting position, picks up the knife with one hand and places it lengthwise on the surface of the drawn foreskin. With a stick on the other hand he gives a sharp blow. If he does not succeed in the first blow he gives the second until he exposes the head of the penis. In some instances, the operated person faints, and in this case the operator slaps his face to bring back consciousness, then applies the medicine and dresses the wound and the boy is considered baptized (*biñagan*) (Plate 1, fig. 1).

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[2] Op. cit. 40 (1905) 220.

[3] Op. cit. 43 (1905) 110.

[4] Op. cit. 40 (1905) 365.

*Tuli sa itak.*—A well-sharpened bolo (*itak*) is provided for this operation. The point of the bolo is inserted lengthwise between the prepuce and the head of the penis while the handle drops to the ground. Both the operator and the one to be operated are in a squatting position. With the left hand of the operator drawing the prepuce on the edge of the bolo towards him, he strikes the prepuce with a piece of banana leaf petiole in his right hand until he succeeds in exposing the head of the penis. Medicine is applied, the wound dressed, and the operation is finished (Plate 1, fig. 2).

*Tuli sa gunting.*—A pair of sharp scissors (*gunting*) is necessary for this method. One point of the scissors is inserted through the opening of the prepuce. Then the prepuce is stretched lengthwise on the edge with one hand and with the other slitting is accomplished. The wound is treated, dressed, and the process is over (Plate 2, fig. 1).

*Tuli sa bao.*—This method is an imitation of the Chinese way of circumcising their boys. It is commonly known as *tuling intsik.* Of all the mutilations described above this is the most sacrificial one because above all, the wound is circular in nature and besides the time needed in healing is quite long, for the cut borders of the prepuce could hardly be kept together as they are not sutured. The instruments needed are a polished coconut shell (*bao*) with a hole in the center and a razor. The prepuce is inserted through the hole and is stretched forward so that the head of the penis rests behind the hole of the shell. The victim holds the shell firmly with his two hands, while the circumciser with his hand holding the stretched prepuce amputates it crosswise. The wound is treated and dressed and the person is considered circumcised (Plate 2, fig. 2).

The medicine applied in all of the operations described is young guava leaves masticated in the form of a paste either in the mouth of the operated or the operator. The dressing material used is a circular or rectangular piece of cloth with a hole in the center, termed *baro* locally. The size of the hole is determined by the diameter of the penis. The head of the penis passes through the hole and the baro is fastened against the corpus penis so as to keep the cut borders of the prepuce together. A day after the operation the wound is thoroughly washed with a solution made by boiling guava leaves in water. This process of cleansing the wound is locally known as *langas*. After this fine scrapings of coconut shell are applied. Then the penis is held over the smoke produced by burning fresh jackfruit leaves, a procedure calle *suob*. This is done so as to reduce the swelling of the penis. Once a day the wound is washed and dressed with new materials. This process continues until the wound is perfectly healed. The usual treatment lasts from ten days to one month.

Aside from the artificial methods of circumcision there is what is called natural circumcision. The prepuce by nature is very short and even if the foreskin is not mutilated the head of the penis comes out naturally after the preputial adhesion has been destroyed. In such a case circumcision is no longer needed for this is already in a prophylactic condition.

### WHY EVERY MALE PERSON SHOULD BE CIRCUMCISED

Circumcision does not stand alone as a bodily mutilation for beauty. Unlike other mutilations, such as those performed on the skull, face, teeth, skin, finger, and toe which are merely done by mankind to secure permanent amulet or charm, circumcision arose from a protective motive.

> To speak of circumcision folklore may seem to imply an irrevent view of a practice which has acquired great theologic, ethnic and prophylactic significance.[5]
>
> Circumcision has been advised in most cases for one of three reasons: First, a long redundant foreskin, with or without preputial adhesions. Second, a varying degree of irritation about the genitalia, especially the foreskin. Third, a varying degree of balanitis (inflammation of the glans penis).
>
> Other less common reasons assigned as an indication for circumcision are: enuresis, masturbation and nervousness.[6]
>
> The operation is performed chiefly for purposes of cleanliness and to facilitate removal of the smegma, which normally collects beneath the foreskin, but sometimes is necessary to allow free passage of urine. For this purpose it is done as a preventive measure in the infant. In adults the

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[5] Kierman, James G., Urologic and Cut. Rev. 25 (1921) 608.

[6] Lanman, Thomas H., Boston Med. & Surg. Journ. 190 (1924) 628.

chief reason for its performance is balanitis or inflammation beneath the foreskin due to lack of cleanliness or to the presence of a venereal sore; in this case circumcision is a necessary part of the treatment.[7]

. . . all), however, circumcise themselves, saying that they do it for their health and for cleanliness.[8]

This operation has been in practice for a long time, and nearly all have submitted themselves to it. An uncircumcised person is considered ridiculous and is taunted by his friends by the terms *suput, suputino, apog, sungao,* and *buenos días.*

Among them being uncircumcised is looked upon as a defect so much so that children of both sexes cruelly taunt those who have reached the age of puberty and are still uncircumcised. They apply to them with the intent to insult the term *suput,* which originally meant "constricted" or "tight", but has come to mean "one who cannot easily gain entrance in sexual intercourse." When American troops first came to Hagonoy and bathed in the river, the fact that they were uncircumcised was a subject of great gossip in the market place.[9]

[7] Encyclopœdia Britannica 5 (1929) 720.

[8] Blair and Robertson, op. cit. 5 (1905) 119.

[9] Barney, Charles Norton, Journ. Assoc. Milit. Surgeons U. S. 13 (1903) 159.

# ILLUSTRATIONS

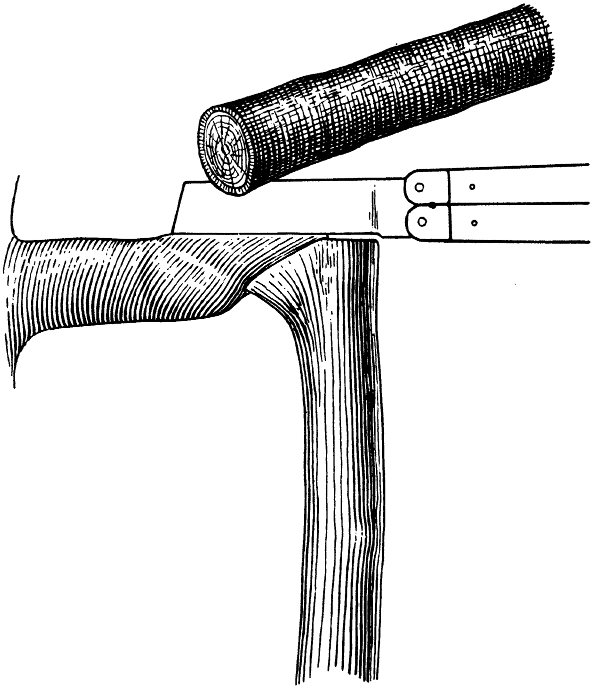
[Drawn by V. V. Marasigan, H. T. Costelo, and R. C. Aguilar, of the National Museum Division.]

### PLATE 1

FIG. 1. The *tuli sa batakan*.
2. The *tuli sa itak*.

### PLATE 2

FIG. 1. The *tuli sa gunting*.
2. The *tuli sa bao*.
3. Penis before circumcision.
4. Penis after slitting, showing the length of the slit.
5. A circumcised penis.



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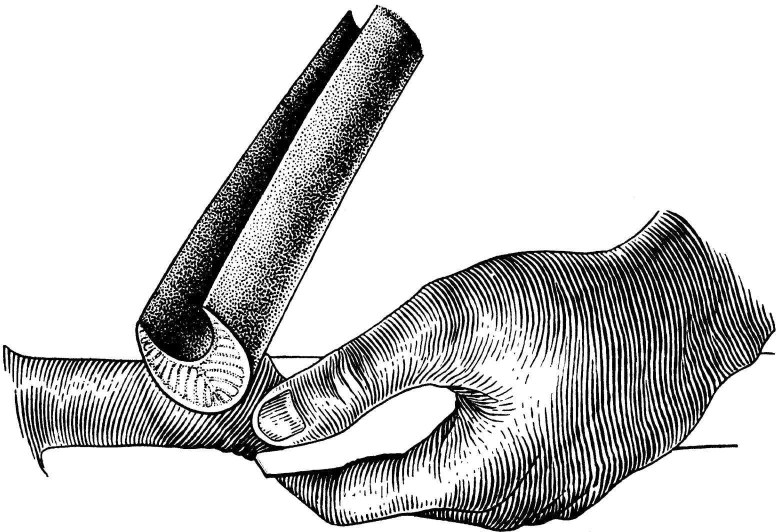

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PLATE 1.

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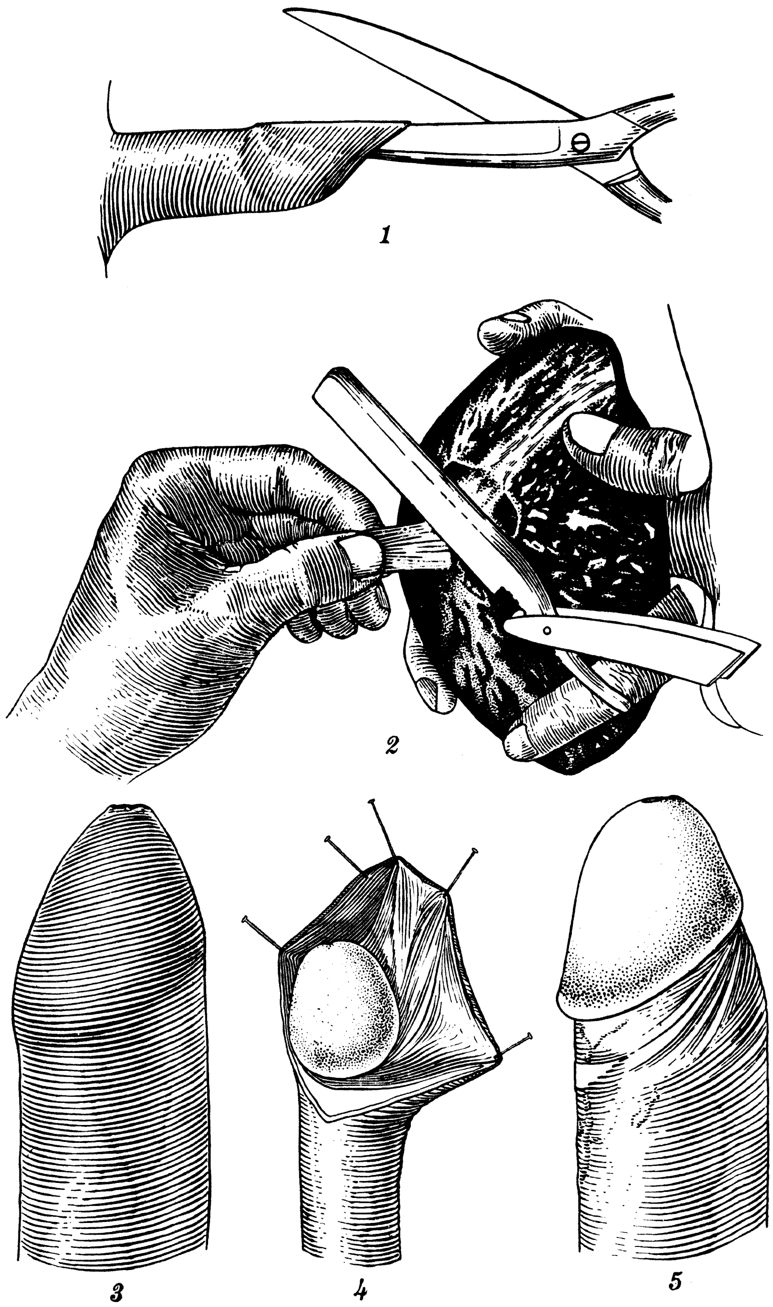

PLATE 2.

UNIV. OF MICH.

# THE CULTURE OF THE SIAMESE FIGHTING FISH BETTA SPLENDENS [1]

By JOSÉ S. DOMANTAY

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*Betta splendens* Regan, commonly known as the Siamese fighting fish, because of the instinct of the males to fight when placed together, was introduced into the Philippines from Siam about four or five years ago. During its first year in the Philippines it was the most expensive ornamental fish. A pair commanded as much as 40 pesos. Later, the price fell to 25, to 20, to 14, and so on, to as low as 1 peso at present.

January 2, 1934, a pair of *Betta splendens* was given to the writer by Mr. Lek Laksanahuta, a Siamese. According to the information given by Mr. Laksanahuta, this fish is very common in Siam and is found even in places where carabaos wallow, in small ponds, and rice fields. In Siam the male is used in place of the game cock for purposes of betting.

*Breeding.*—Before starting to breed, one must decide on the color or colors of the fish desired. Likewise, he must know the mode of transmission of the different colors if he is to control the kind to be produced. Although there are many kinds of fighting fishes of different colors now available in the market, there are only two principal groups. One of these is the Cambodian fighting fish, whose body color is typically creamy white and fins and tail are reddish. The other is the Siamese fighting fish, whose body and fins are either greenish blue, gray, reddish, or violet. According to the preliminary breeding results of Dr. L. S. Clemente, of the Department of Zoölogy, University of the Philippines, who is doing research along this line, the color of the Siamese fighting fish, irrespective of kind, was found to be dominant to the Cambodian color. Thus, when a pure Siamese fighting fish of green color is mated to a pure Cambodian, all the offspring show the green color of the Siamese parent.

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[1] Read before the Third Philippine Science Convention, February 27, 1935.

If the hybrid Siamese from the above mating are bred together, the resulting offspring are of two kinds in the proportion of three green Siamese to one Cambodian. However, when the hybrid Siamese is mated to a pure Cambodian, the results are of two kinds; namely, green Siamese and Cambodian color in about equal number. Mating pure Cambodian to pure Cambodian has been found to produce nothing but pure Cambodian. The same was found to be true when pure Siamese fishes were mated. Knowing these principles, a breeder can more or less produce the color desired.

Besides color, the vigor of the parents should be considered. Vigorous parents tend to produce strong offspring in which the percentage of mortality is small.

Once the stock is selected, the male must be well fed before mating as it will hardly take any food while caring for the eggs and the young. Likewise, the female should also be fed well. The selected pair must be housed in separate jars, or aquaria, and placed side by side in such a way that they can see each other. It is preferable that the male be placed in a more or less permanent balanced aquarium. When both are ready to mate, the male will be seen to build a froth nest, which is composed of a thick foam of bubbles. The nest of bubbles when completed, appears as a thick white foam and is slimy or adhesive. While building the nest the male, from time to time, swims in the direction of the female, displaying his brilliant colors. The female, when ready, may be seen responding by showing alternate dark and light bands across her body. Her belly is well distended with the eggs partly visible from the outside. The visibility of the eggs, which are partly protruding from the anal opening, indicates that the female may be placed with the male.

On being placed together, the male will start chasing the female; when the latter is cornered, the former will show his color to the full, with his tail, fins, and operculum fully spread. The female, even if ready, usually requires "taming" or "courting." This process may be continued from six to twelve hours before they finally mate. During the taming process the male reënforces his nest by blowing bubbles at more or less regular intervals until it forms a thick foam. The female usually suffers much from physical injuries during taming or courting. The male attacks her from time to time and often mutilates her scales, tail, and fins. There are several cases known to the writer where the female died from the wounds inflicted by the male. When the female is not ready to breed, she cannot be tamed at all. She should, therefore, be separated immediately from the male, otherwise she will be killed or become disabled.

*Mating.*—After the female is won, the two display their colors to the fullest extent with their fins and tails widely extended. Soon they begin to swim closely side by side with their fins unexpanded. The male then bends his body on one side and approaches the female, which does the same thing as a sign of positive response. The male then grasps the female by bending his body over the latter with his operculum touching one side of the female's abdomen while the rest of his body presses the other side. The female reacts by turning around with her ventral side up. The male follows the movement of the female and then tightens his grasp with his head and tail. As the male releases his hold, the female drops motionless for a while and then regains her balance. The male immediately darts for the eggs, which are falling from the vent of the female, and picks them up, one by one, in his mouth. The eggs are then placed in the nest of bubbles by blowing them out under it. Here they appear in a mass the size of which depends upon the number of eggs laid. Sometimes the female helps in the gathering of the eggs. This process of pairing and egg-collecting is repeated over and over until all the ripe eggs are squeezed out of the female. The duration of the mating varies from two to three hours. According to my observations the average duration of egg-laying is about two and one-half hours. The average number of pairings, which take place at an interval of less than a minute, is one hundred per mating period. During the early part of the pairing practically no eggs are laid. From the tenth up to the fortieth pairing, the female lays at the rate of three eggs per pairing. After this, the rate reaches an average of ten eggs per pairing. This rate continues up to almost the end of mating, although in the last few pairings the number of eggs decreases. The average number of eggs laid is five hundred, although this depends somewhat upon the size of the female. Large females produce more eggs than do small ones. While the male has his body coiled around the female, the spermatozoa are being discharged into the water in the neighborhood of the female's vent. Thus, the eggs become fertilized as fast as they are discharged by the female.

Soon after all the mature eggs are laid, the male drives the female away and guards the nest. When this happens, the female must be removed, especially if the breeding aquarium is small. In a large breeding aquarium, with plenty of aquatic plants or rocks where the female can hide, she need not be removed.

I had a case in which two individuals were mated before the nest was ready. When the eggs were laid, the male after picking them up in his mouth, just blew them up with air bubbles in the water. Because of the absence of the froth nest, the eggs were scattered all over the surface of the water. However, when the pairing was over, the male began to construct the froth nest and later gathered the eggs together under the nest.

*Care of the eggs.*—One of the most interesting features about this fish is that the male cares for the eggs and the young. By continuously blowing bubbles under the foam, he aërates the eggs and at the same time reënforces the nest. He picks up any eggs that fall to the bottom of the aquarium and deposits them in the nest. It is probable that the continuous movement of the male at this time, together with the constant motion of his fins under the foam, helps to aërate the eggs. It is apparent that aëration and care by the male is very essential in the hatching of the eggs. Experience shows that an early separation of the male is detrimental to the development of the eggs. Eggs that are isolated from the batch in the nest fail to develop, presumably because of lack of proper aëration.

During the period of caring for the eggs, the male does not feed at all. He does not eat even if he is given plenty of mosquito larvæ or other kinds of food. He may pick up one or two larvæ, but he does not readily swallow them as he does when not caring for the eggs and the young. This is perhaps an adaptation to prevent him from feeding upon his young. It is, therefore, necessary that he be well fed before mating. When starved the male may devour all the eggs.

The time required for hatching apparently depends on room temperature. The incubation period is shorter when the room temperature is high and longer when it is low. During the hot season it takes about thirty hours for the eggs to hatch.

*Care of the young.*—The male also exercises great care over the young fry after hatching. The newly emerged fishes are usually attached vertically to the adhesive foam. A slight jarring or movement of the water causes some of them to drop with their head down. The stronger ones may again reach the top without the help of the male by darting upward in a spiral way. The weaker ones fall directly to the bottom and die if not attended to by the male. It is at this particular period that the presence of the male is absolutely necessary. He darts after them and picks them up, one by one, and later puts them back on the surface. The time required from the hatching of the eggs to the time when the fry can swim horizontally is from thirty-six to sixty hours. It is not advisable to remove the male even a few hours prior to the time when the fry can swim freely. The male may stay with his young indefinitely provided that his association with them is not interrupted. When the male is removed from them for sometime and then is returned, he begins to eat them.

*Period of growth.*—The newly hatched fry measures about 3 millimeters in length. It does not eat at this time and is nourished by the yolk, which is very conspicuous at the posterior end of its abdomen. Three days later the fry has to be supplied with food as the yolk is entirely absorbed at this time. As it starts to swim actively, it begins to look for food, which consists mostly of *Paramecium* and young *Daphnia.* For a month or more the young fry depends on this food for its proper development. In case there are plenty of *Daphnia,* or water fleas, a large number of them must be placed in the breeding aquarium soon after the fry can swim freely, otherwise the male will mistake his young for food. In a few days, the water fleas will produce young in great quantities, which will serve as food for the fry. *Paramecium* need not be supplied if the water fleas are given. As the fry grow bigger, they feed on larger *Daphnia* and very young mosquito larvæ. The first month is the most delicate period in the life of these fishes. However, so long as they are properly fed with *Paramecium* and other protozoa or with tiny young *Daphnia,* and as long as the water is not too acid, the mortality is small.

After two months sex differences become visible. In the male the ventral fin grows longer and the color is more intense. The fighting instinct may also start to develop at this time. Young of the same age do not usually grow at the same rate and do not mature at the same time. Those that grow fast mature early. It is size rather than age that determines maturity. Some mature as early as three months, while others do not mature even after a longer period of time. Exceptional cases were reported by Mr. Thorson, of Manila, who was able to raise fighting fishes to maturity in a record time of fifty-six days. The difference in the rate of growth and maturity is mainly due to food. Live and fresh food hasten growth rate and maturity more than does preserved food. A year-old fish which was kept in a small aquarium without proper feeding had the size of one that was only about a month old but properly fed.

*Rearing.*—An aquarium ranging from 6 by 8 by 12 inches to 12 by 12 by 24 inches serves as a good breeding container. A permanent breeding aquarium must be provided at the bottom with a layer of soil 0.5 to 1 inch thick, followed by a thin layer of gravel and a similar layer of sand. Water should be added in such a way that the sand is not too stirred. This may be done by placing a piece of glass over the layer of sand while the water is being gradually poured. Aquatic plants, such as *Sagittaria, Vallisneria, Elodea, Hydrilla,* and *Cabomba,* may be planted so as to make it a balanced aquarium. In a few days after the water has cleared up, the aquarium may be ready for breeding purposes. In this type of aquarium the water need not be changed.

If the breeding aquarium is small, some of the fry may be transferred to other aquaria after one or two weeks. However, if the aquarium is large, the fry need not be transferred to another container. Here they can be kept for a month or two when properly fed. Afterwards, when they are about one or more centimeters long, they may either be transferred en masse to a larger tank or be placed singly in good-sized wide-mouth bottles. With proper care and feeding the rate of growth of fishes in these bottles is remarkable. It is with this isolation method that Mr. Thorson was able to induce maturity in a much shorter time than is usual. When the mass method is preferred to the isolation method, they may be transferred to a good-sized glass or concrete tank where they may be left together indefinitely. It is not advisable to place together young of different sizes belonging to different batches. When they differ greatly in age and size, the older and larger ones eat or harm the smaller ones. Moreover, during feeding the large ones have a decided advantage over the small ones.

Both the isolation and mass method of rearing the young after they are transferred from the breeding aquarium are effective and successful. The only difference between them is that in the isolation method more care and attention are needed. In mass culture one can leave them in the tank with very little care and attention.

*Food.*—The most important problem to be encountered in the rearing of the young is food. The rate of growth of the young depends on the amount and kind of food they get. From the time the fry is able to swim freely and horizontally it begins to look for food. At this stage it should be given enough *Paramecium.* A culture of *Paramecium,* therefore, must be ready before the eggs are hatched. It can be prepared in many ways. The most effective method is by placing dried grass or hay in glass or battery jar containing pond water. The jar is then covered with a glass plate to prevent mosquitoes from laying eggs in it. Other materials like dried banana, papaya leaves, fresh grass, and lettuce leaves may be substituted for hay. Hay extract also can be used, provided some paramecia are introduced later after it has cooled. Water plants and algæ, such as *Hydrilla, Elodea, Chara, Spirogyra,* etc., when placed in a glass bowl in large quantities, will also serve as a good medium for the growth of *Paramecium.* It is easy to detect whether the culture is rich or poor by placing a sample of the water from the culture in a clear glass bottle and then examining it against the light. The appearance of a white cloudy scum on the surface and along the wall of the container usually indicates the presence of a large number of Protozoa. A good substitute for paramecia are the young of *Daphnia* which have been mentioned previously.

In feeding the fry with these paramecia utmost care must be exercised. A clean pipette must be used to remove them with the least amount of the liquid medium, otherwise, the water in the aquarium will be very acid. The success in obtaining the greatest percentage of survivors during this critical stage in the life of the fry depends on the technic of feeding. They must be fed with paramecia at least twice a day for about a month. After this period the food may be changed to newly hatched mosquitoes or young *Daphnia.* The food which gives the best result are the young *Daphnia.* These little crustaceans occur in nearly all bodies of fresh water. The success of the ornamental fish breeder depends upon these little crustaceans as they are the best food for all ornamental fishes in any stage of their development, from fry to adult.

Therefore, one must have a constant supply of these crustaceans in order to assure his success. These food materials may be collected from time to time in open water reservoirs, ditches, ponds, and rice paddies. These sources, however, are not very dependable because they usually dry up during the hot season. The enterprising breeder must not, therefore, depend upon the natural source of these crustaceans, but must resort to artificial cultivation in order to maintain their constant supply.

Recently my attention has been attracted by the success of Mr. Manalang of the University of the Philippines in obtaining almost complete success by feeding the fry only with *Daphnia* and not with infusoria. This was done by placing a large number of *Daphnia* with the fry soon after the male was removed. *Daphnia* lay eggs from which emerge young which serve as excellent food for the fry. I repeated the same technic and I succeeded in obtaining a large number of young which reached their medium size in a little over a month. Although this technic is successful with the fighting fishes, as well as with paradise and dwarf gourami, it is not altogether a success with other fishes, like the zebra.

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